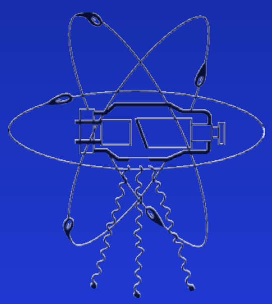
2008 NASA TRIENNIAL HEALTH PHYSICS CONFERENCE



MAY 12 - 16, 2008

DOUBLETREE OCEANFRONT HOTEL
COCOA BEACH, FLORIDA

2008 Triennial Health Physics Conference

National Aeronautics and Space Administration

Headquarters
Washington, DC 20546-0001

February 26, 2008

Reply to Attn of: Chief Health and Medical Office

TO: NASA Center Environmental Health COTRs
NASA Center Medical COTRs

FROM: Chief Health and Medical Officer

SUBJECT: NASA Health Physics Conference

The Office of the Chief Health and Medical Officer is holding its Triennial Conference for NASA Health Physics Professionals at the Double Tree Hotel in Cocoa Beach, Florida on May 12-16, 2008. This is the third in a series of Agency-wide Health Physics conferences. It provides the means to exchange scientific and technical data and management experiences and is valuable to all Environmental Health professionals who have ionizing or nonionizing radiation safety job responsibilities at NASA Centers and Facilities.

The agenda for this year's conference will include 24 continuing education hours devoted to ionizing and non-ionizing radiation safety in a format to refresh and build technical skills, and aid those pursuing American Board of Health Physics credentials. The balance of the agenda is planned for Center technical presentations covering Radiation Protection Program elements, including policy and procedures, use authorization processes, training programs, and hazard software demonstrations. Mr. Steve Rohring from the Federal Aviation Administration (FAA) will discuss coordination of NASA outdoor laser operations and provide a demonstration of the FAA's new laser hazard software.

I encourage every NASA Center and Facility to participate in this important technical gathering of radiation safety professionals for quality training, networking, and sharing of information and experiences. Additional information and registration details are online at the NASA Occupational Health website,
http://ohp.nasa.gov/conference_info/conf_gen/2008/hpconf/index.html.

If you have questions about the Conference, please contact Mr. Guy Camomilli at (321) 867-1417 (guy.camomilli-1@ksc.nasa.gov) or Ms. Janine Hardin at (321) 867-2961 (janine.e.hardin@nasa.gov).

Richard S. Williams, MD, FACS

Continuing Education

American Board of Health Physics

8 CE Credits

American Board of Industrial Hygiene

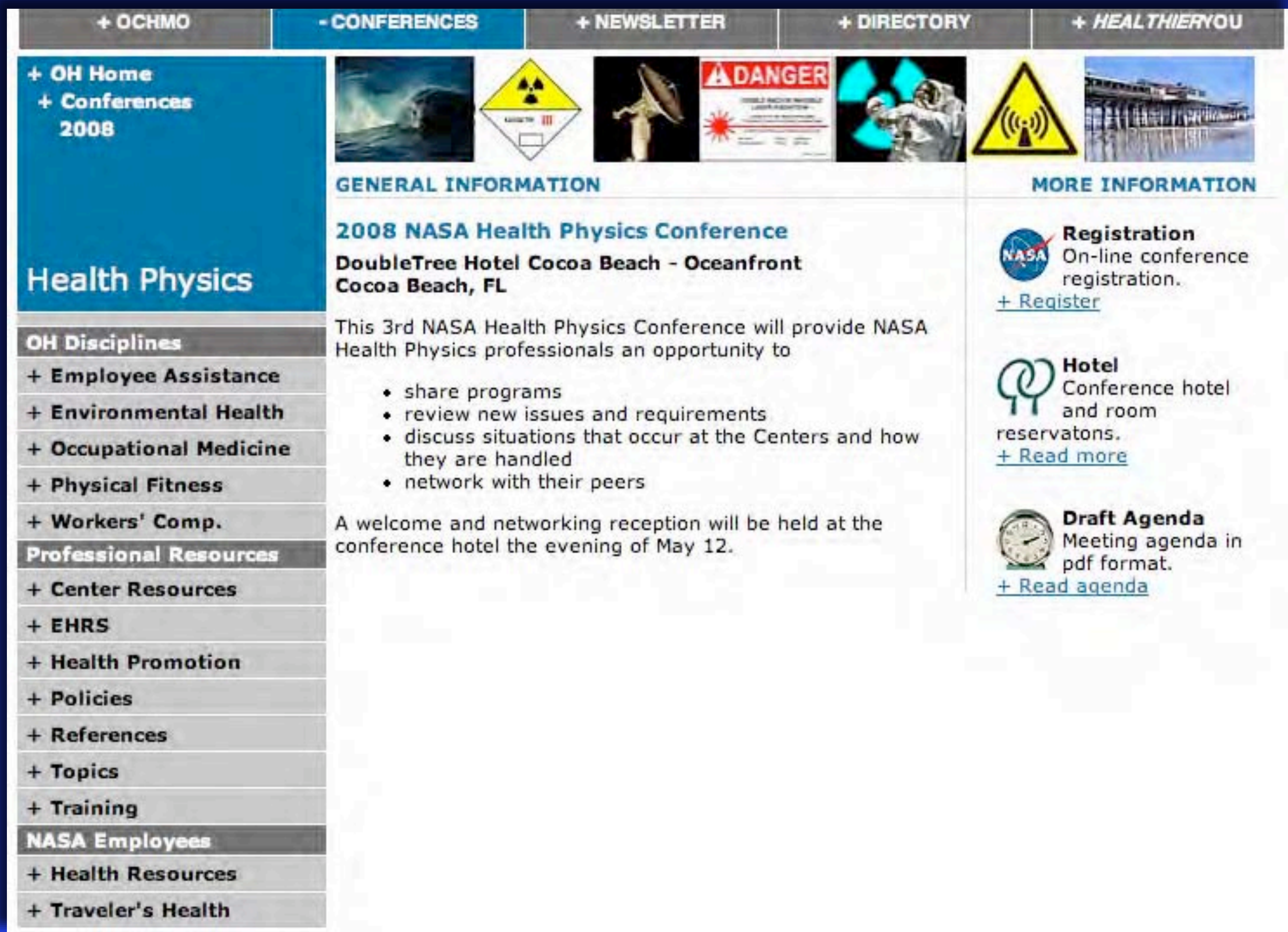
4.5 CM Points

Meeting at a Glance:

- May 12 - 16, 2008
- Hybrid Agenda / Technical Program
- ABHP Board Certification Review
- Center Presentations
- Technical Tour
- 12 Centers and Facilities Represented
- 36 Attendees

Online Registration

2/8/2008



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+ OH Home
+ Conferences
2008

Health Physics

OH Disciplines
+ Employee Assistance
+ Environmental Health
+ Occupational Medicine
+ Physical Fitness
+ Workers' Comp.

Professional Resources
+ Center Resources
+ EHRS
+ Health Promotion
+ Policies
+ References
+ Topics
+ Training

NASA Employees
+ Health Resources
+ Traveler's Health

GENERAL INFORMATION

2008 NASA Health Physics Conference

DoubleTree Hotel Cocoa Beach - Oceanfront
Cocoa Beach, FL

This 3rd NASA Health Physics Conference will provide NASA Health Physics professionals an opportunity to

- share programs
- review new issues and requirements
- discuss situations that occur at the Centers and how they are handled
- network with their peers

A welcome and networking reception will be held at the conference hotel the evening of May 12.

MORE INFORMATION

Registration
On-line conference registration.
+ Register

Hotel
Conference hotel and room reservatons.
+ Read more

Draft Agenda
Meeting agenda in pdf format.
+ Read agenda

PREFACE

The Office of the Chief Health and Medical Officer sponsored the third NASA conference for the professional development of Radiation Safety specialists and improvement of center programs and procedures. The conference was held in Cocoa Beach, FL the week of May12 through 16, 2008. The agenda was planned to meet the broad range of training needs for the entire health physics discipline practiced at all of the centers and facilities. Approximately twenty-four hours of continuing education and skills building/refreshing in formal health physics was offered for a combination of experience and college-level lectures in a style to maximize preparation for Part 1 of the American Board of Health Physics certification exam. This meeting was designed for all NASA Health Physics staff regardless of experience or education level. Center participation was crucial to the success of this meeting. Each center contributed to that success by sending a representative or two to share experiences from their center; to make a presentation on a specific aspect of their program that demonstrates a good practice or highlights a particular strength.

Agenda Day - 1

Monday May 12, 2008

7:00 – 8:00	Continental Breakfast	
8:00 – 9:30	Certification exam review – *T. Johnson, PhD, CHP*	
9:30 – 9:45	Break	
9:45 – 12:00	Certification exam review – *T. Johnson, PhD, CHP*	
12:00 – 1:00	Lunch (on your own)	
1:00 – 2:30	Certification exam review – *T. Johnson, PhD, CHP*	
2:30 – 2:45	Break	
2:45 – 5:00	Certification exam review – *T. Johnson, PhD, CHP*	
6:00 – 8:00	Welcome Reception – *Pool Deck*	

Agenda Day - 2

Tuesday May 13, 2008

7:00 – 8:00	Continental Breakfast
8:00 – 9:30	Certification exam review – ***T. Johnson, PhD, CHP***
9:30 – 9:45	Break
9:45 – 12:00	Certification exam review – ***T. Johnson, PhD, CHP***
12:00 – 1:00	Lunch (on your own)
1:00 – 2:00	Certification exam review – ***T. Johnson, PhD, CHP***
2:00 – 2:30	KSC HP Program - Overview and Laser Safety Emphasis – ***R. Nickell & R. Scott***
2:30 – 2:45	Break
2:45 – 3:15	ARC HP Program – Monitoring Radiography Operations – ***E. Packard***
3:15 – 3:45	MSFC HP Program – X-Ray NDE – ***P. Brown***
3:45 – 4:15	MAF ALARA Program – X-Ray NDE – ***A. Rovira***
4:15 – 5:00	GRC HP Program – Decommissioning Experiences – ***R. Case & C. Blasio***

Agenda Day - 3

Wednesday May 14, 2008

7:00 – 8:00	Continental Breakfast
8:00 – 9:30	Certification exam review – ***T. Johnson, PhD, CHP***
9:30 – 9:45	Break
9:45 – 12:00	Certification exam review – ***T. Johnson, PhD, CHP***
12:00 – 1:00	Lunch (on your own)
1:00 – 2:00	Certification exam review – ***T. Johnson, PhD, CHP***
2:30 – 7:00	KSC Technical Tour

Agenda Day - 4

Thursday May 15, 2008

7:00 – 8:00	Continental Breakfast
8:00 – 9:30	Certification exam review – ***T. Johnson, PhD, CHP***
9:30 – 9:45	Break
9:45 – 12:00	Certification exam review – ***T. Johnson, PhD, CHP***
12:00 – 1:00	Lunch (on your own)
1:00 – 2:00	Certification exam review – ***T. Johnson, PhD, CHP***
2:00 – 2:30	Medical X-Ray Compliance – ***J. Bai***
2:30 – 2:45	Break
2:45 – 3:45	Medical X-Ray Compliance – ***J. Bai***
3:45 – 5:00	FAA Outdoor Laser Safety & Software Demonstration – ***S. Rohring***

Agenda Day - 5

Friday May 16, 2008	
7:00 – 8:00	Continental Breakfast
8:00 – 8:30	LaRC HP Program – Outdoor Laser Safety – ***K. Merritt***
8:30 – 9:00	GSFC Outdoor Laser Safety – ***T. Simmons***
9:00 – 9:30	GSFC HP Program – Source Inventory – ***D. Simpson***
9:30 – 9:45	Break
9:45 – 10:15	WFF RF Hazard Assessment Database – ***M. Bunting***
10:15 – 11:00	Mars Science Lab Launch Support at KSC – ***R. Scott & E. Provost***
11:00 – 11:30	Agency Health Physics Policy – ***K. Geber***
11:30 – 12:00	Conference Summary and Closing Remarks – ***G. Camomilli***

ABHP Board Review

Thomas Johnson, Ph.D., CHP

- Lasers
- RF and microwave radiation
- Machine generated radiation
- Nuclear fuel cycle
- Instrumentation
- Dosimetry
- Shielding
- Emergency response
- Radiation protection programs
- Regulations

ABHP Board Review

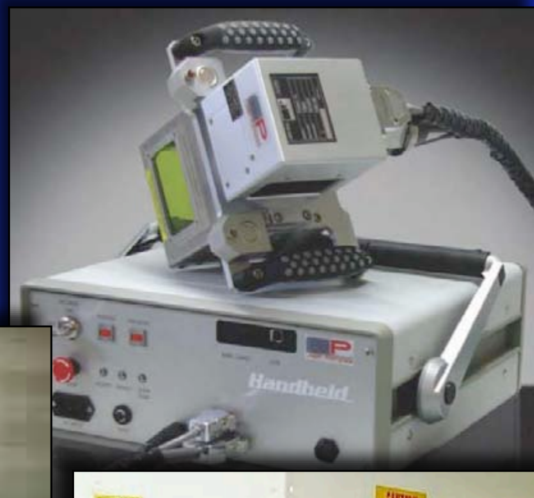
Thomas Johnson, Ph.D., CHP

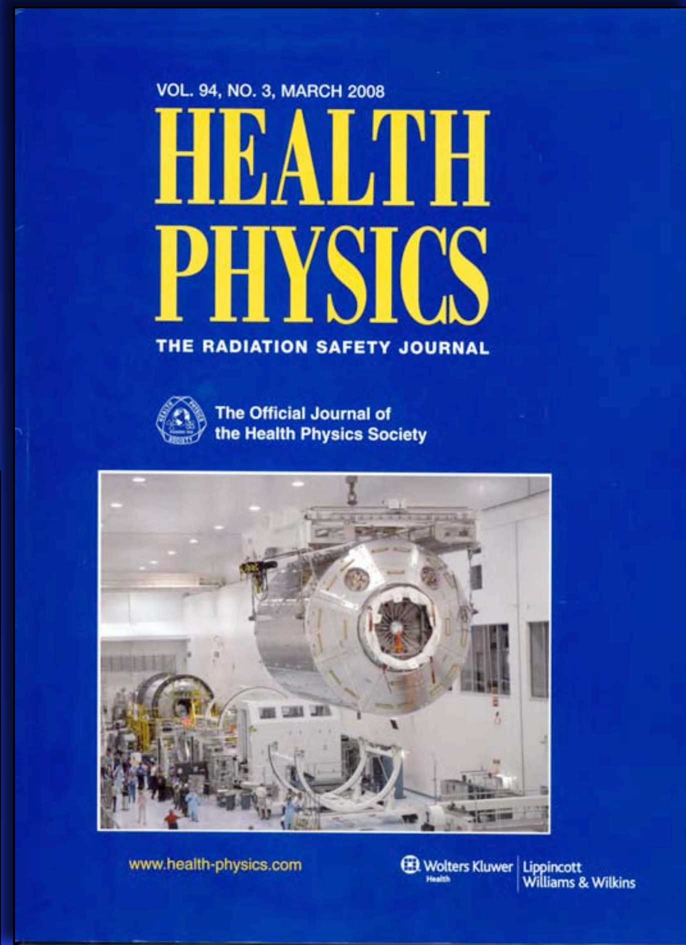
Dr. Thomas Johnson is an Assistant Professor in the Department of Environmental and Radiological Health Sciences at Colorado State University. His research efforts are on decontamination of surfaces, acute effects of ionizing radiation, the effect of lasers on the skin and cornea and laser safety standards. Prior to attaining his current position, he was an Assistant Professor and Post Doc at Uniformed Services University. He holds a BS from Southern Illinois University, an MBA from the University of Illinois, an MS in Environmental Engineering from Northwestern University and PhD in Health Physics from Purdue University. Currently he teaches two classes on radiation detection instrumentation at Colorado State University at the graduate level. These classes examine theory and application of instrumentation and statistics associated with radiation detection. He has worked in consulting, electric generating plants, and hospitals. During his tour in the Navy he was a nuclear power plant operator on the fast attack submarine USS Cavalla. He is currently a reservist in the USAF on the Air Force Radiation Assessment Team. His position on the Air Force Radiation Assessment team requires extensive knowledge of the use and limitations of radiation detection equipment in a variety of situations with all types of radionuclides. Both positions require him to maintain extensive knowledge of the latest developments in radiation detection instruments and techniques. He is co-author with Herman Cember of the textbook "The Health Physics Solutions Manual" and is currently working with Dr Cember on the fourth edition of the textbook "Introduction to Health Physics". Additionally, he is a Certified Health Physicist, and Registered Radiation Protection Technologist.

Welcome Reception

KSC Health Physics Program

Randy Scott and Rod Nickell

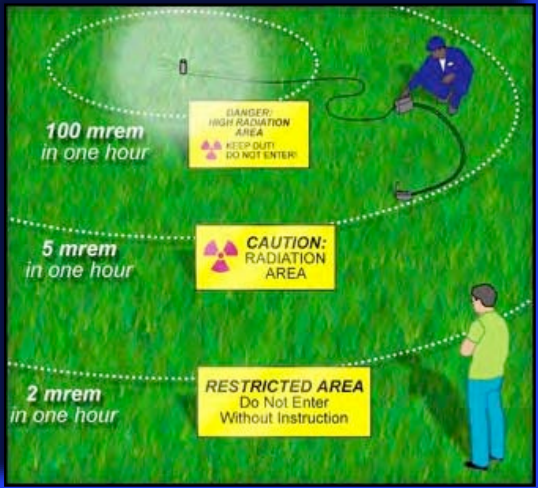




Ames Health Physics Program

Eric Packard

- Auditing Radiography Operations
- Common Regulatory Violations
- Administrative & Engineering Controls
- Compliance and Safe Operations



MSFC Health Physics Program

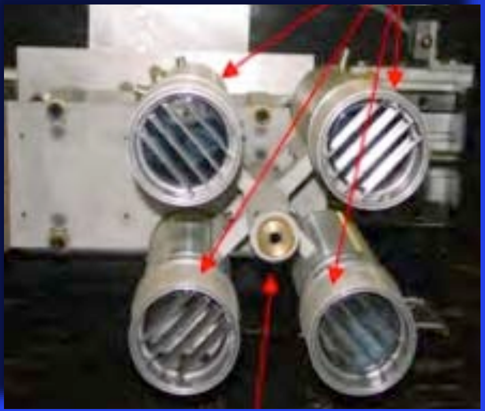
Philip Brown

- Conventional, CT, Back-scatter, and 2 MeV Linac Operations
- Organizational Issuances
- Log Books and Routine Surveys

MAF ALARA Program

Alan Rovira

- Conventional, Back-scatter, & Digital X-ray
- Certified Tools and Field Releases
- Low Energy X-rays & Low Personnel Doses



Plum Brook Reactor Decommissioning

Rod Case

- Derived Concentration Guidelines
- Final Status Surveys
- Buried and Embedded Piping Challenges
- Environmental Sampling

GRC Cyclotron Decommissioning

Christopher Blasio

- 1955 - 1980   NASA Research
- 1980 - 1990   Cleveland Clinic
- Amending NRC By-product License
- Leverage Plum Brook Experience

Medical X-Ray Compliance

Jerry Bai

- Processor and Dark Room QC
- System Constance Check
- Repeat Analysis
- Screen-Film Contact
- Cassettes and Screens
- Dark Room Fog
- Collimation Checks
- Biennial Qualified Expert Survey
  - Timer & kVp Accuracy and Linearity
  - mA Linearity and Reproducibility
  - Exposure Reproducibility, etc

FAA Outdoor Laser Safety

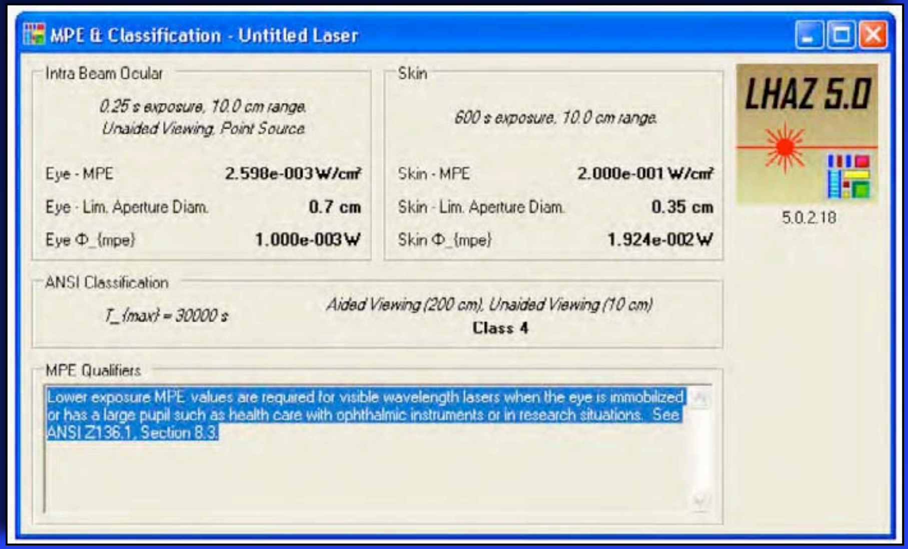
Steve Rohring

Demonstration of FAA Web-Based Laser Evaluation System

LaRC Outdoor Laser Safety

Kim Merritt

- Ground, airborne, and space-based LIDAR and comparison of LHAZ and LAZAN software.
- 75 Active laser permits
- 375 Registered laser workers
- Annual laser audits
- Annual refresher training



GSFC Outdoor Laser Safety

Ted Simmons

- Detailed and comprehensive approach to managing lasers
- 251 Class 3b and 4 lasers
- 152 Registered laser users
- 45 Certified laser labs/projects
- Management certifies Class 1-3a
- Committee certifies 3b & 4

GSFC Health Physics Program

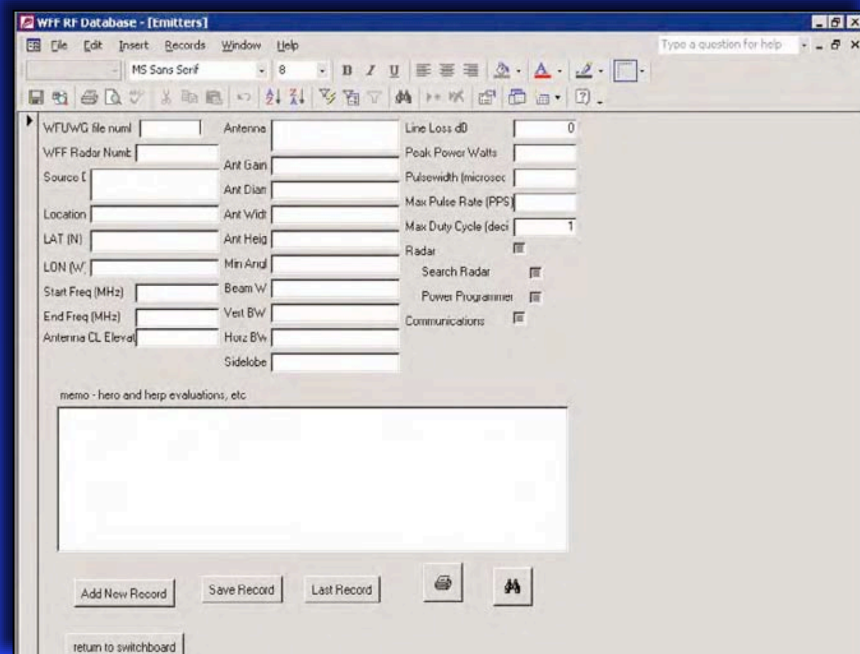
Daniel Simpson

- Inventory
- Leak tests
- Authorized users
- Training records
- Radioactive waste
- Audit checklists
- Inspections
- Calibrations

WFF Radio Frequency Hazard Assessment

Marvin Bunting

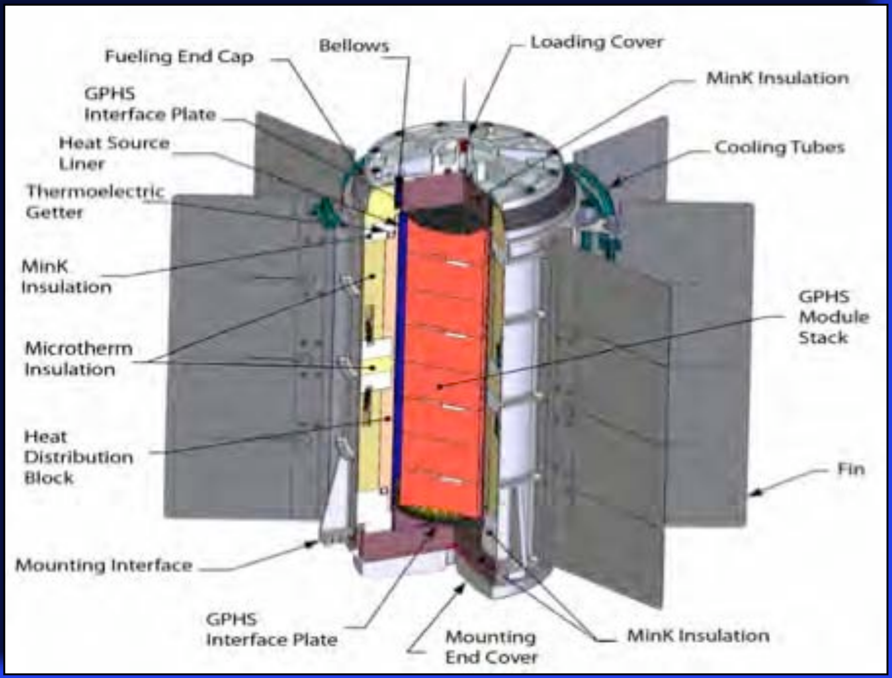
- Access database calculates PELs & hazard distances for radar, orbital tracking & data acquisition
- Frequency Utilization Management Working Group
- 3-D version under development

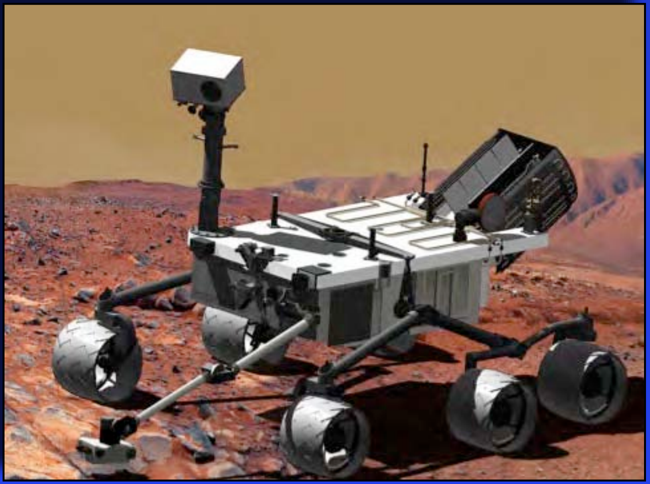


Mars Science Lab Launch Support at KSC

Randy Scott and Edward Provost

- Contingency Planning
- Launch: September 2009
- Volunteer Opportunities





Technical Tour

CENTER PRESENTATIONS

KSC HP Program:
Overview and Laser Safety Emphasis

R. Scott and R. Nickell

Kennedy Space Center

5/13/2008

Kennedy Space Center

GENERAL POLICY

- Centralized Control and Hazard Analysis of Radiation Sources
- Formal and Standardized use Authorization Process
- ALARA Principle (As Low As Reasonably Achievable)
- Applicable to both KSC and CCAFS areas

PROGRAM DOCUMENTS

- KNPD 1860.1 - KSC RPP
- KNPR 1860.1 - Ionizing RPP
- KNPR 1860.2 - Non Ionizing RPP
- 45 SW Instruction

  40-201 - Radiation Protection Program

IONIZING SOURCES

- Radioactive Material
  - Flight and Ground Calibration/Check Sources
  - Radioisotpes in Research
  - Static Meters/Smoke Detectors
  - Heater Units/Power Sources
  - Radiography
- Radiation Devices
  - X-ray Machines (Diagnostic/Industrial)
  - Accelerators

NON-IONIZING SOURCES

- RF/MW Emitters
  - Radar
  - Communications
  - Telemetry
  - RF/MW Generators
  - RF Sealers/Heaters
- Laser/Laser Diodes
  - Alignment/marking
  - Distance and Ranging
  - Fiber Optics
- Optical Sources
  - Infra Red
  - Hi Intensity Visible
  - Ultra Violet

USE REQUEST-AUTHORIZATION PROCESS

- User Completes and Submits KSC Forms
  - Identification & Descriptions
  - Procedures
  - Locations
  - User Qualifications
- Submittal is Evaluated for Hazard Potential and Regulatory Compliance
- Controls and Conditions are Assigned
- RPC Issues approved U/A Package to User

PROVISIONS & GUIDELINES

- Exemptions
  - Negligible or no Hazard
  - Exempt from Controls
- General Use Authorizations
  - Minimal Hazard
  - Valid Indefinitely
  - Hazardous Procedures
- Specific Use Authorizations
  - Moderate to High Hazard
  - Annual Renewal
  - Hazardous Procedures
- Hazard Evaluation
  - Theoretical/CALC
  - Worst Case
- Survey/Measurement
  - Verification & Compliance

Radiation Use Authorization

I. Applicable personnel protective standards

II. Authorized sources and approved use/storage locations

III. Authorized user personnel

   A. Area Radiation Officer (ARO): Individual designated by the user organization's management as their representative for matters pertaining to the local control of radiation hazards
   B. Operators of radiation sources/emitters

IV. Applicable customer operating procedures

Radiation Use Authorization (Continued)

V. Hazard Evaluation

A. Operating Parameters and Protection Guide
B. Range of Hazard Distance

VI. Operational Provisions

A. Operational Controls and Provisions

1. Radiation Control Areas: Defined areas for the control of personnel exposure.
2. Notification Requirements
3. Posting Requirements
4. Inventory/Accountability Requirements
5. General Operating Provisions

B. Administrative Provisions

1. Authorized Period of Use
2. RUA Change Request procedures

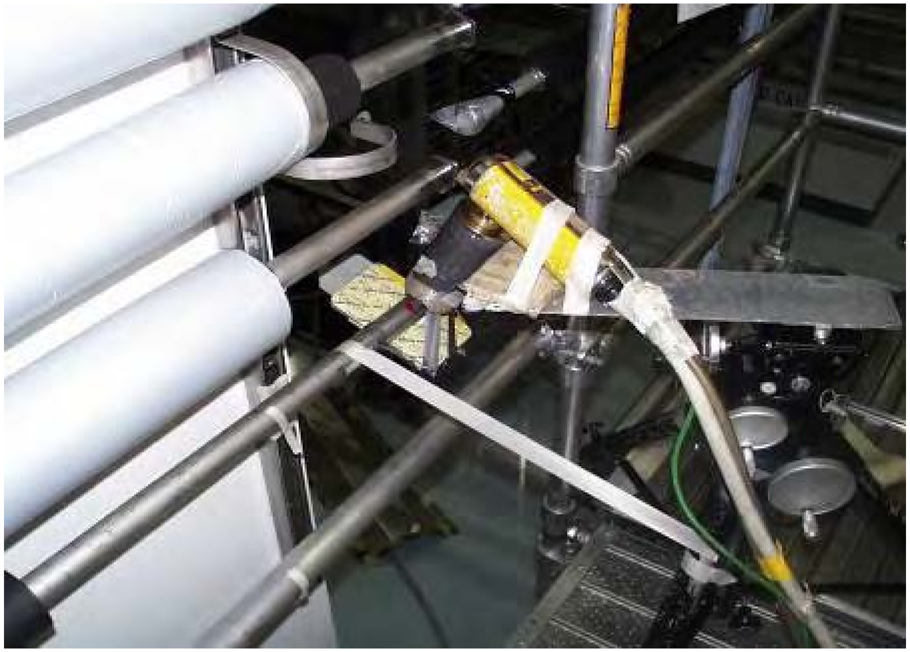
Diagnostic X-Ray Rooms




Industrial X-ray Rooms

X-Ray Cabinet Units

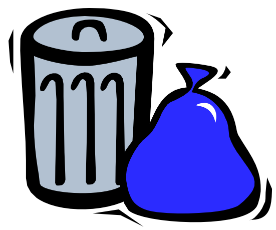
Portable X-Ray Equipment



Portable X-Ray Operations

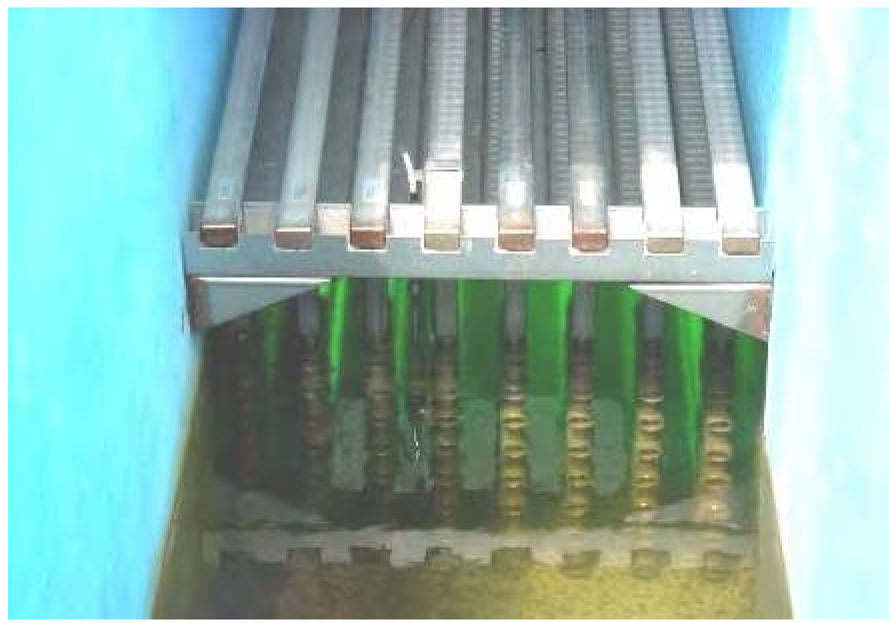
Portable & Fixed Gamma Ray Radiography

Processing Space Trash



Unsealed Radioactive Material Usage

Ultraviolet Radiation Emitters



Radio Frequency Emitters

Radio Frequency Emitters

Enclosed & Fixed Laser Emitters

Mobil Laser Emitters

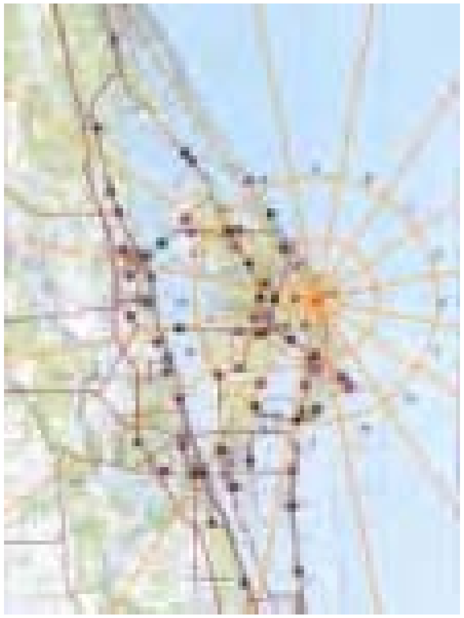
Health Physics Laboratory

Processing of Large Radioactive Source Payloads

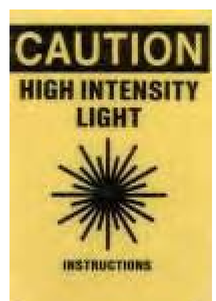





Large RAM Launch Contingency Operations



Evaluate + Calculate + Communicate + Monitor = RPP



Kennedy Space Center Radiation Protection Program

Mission

Ensure the safe use of radioactive materials, radiation producing machines, radio frequency/microwave radiation emitters, and laser or optical (ultraviolet, infrared, and visible) generating devices used at KSC and KSC facilities on Cape Canaveral Air Force Station, and to limit the exposure of personnel, facilities, and the environs to levels of radiation that are As Low As Reasonably Achievable (ALARA).

Safety Record

Historically, the KSC Radiation Protection Program has had an excellent radiation safety record. The program has enjoyed solid support from NASA, Department of Defense, contractor, university, and commercial user organizations. As a result of this cooperation and a through system of written use controls, field audits, and worker radiation safety training, there have been no abnormal personnel exposure incidents to date. Additionally, the program has been evaluated for compliance numerous times by the Nuclear Regulatory Commission, Department of Energy, and the State of Florida Bureau of Radiological Health. No regulatory infractions have been cited. Periodically radioactive heater and power sources, classified as Major Radiological Sources, are incorporated into deep space probes that are launched on expendable and manned missions. Through extensive safety reviews, contingency planning and preparation, worker and general public safety has always been maintained.

Charter

The mission and authority to exercise centralized control over the procurement, use, storage, transportation, and disposition of radiation emitting sources is delineated in KNPD 1860.1, “KSC Radiation Protection Program”, KNPR 1860.1, “Ionizing Radiation Protection Program”, and KNPR 1860.2, “Nonionizing Radiation Protection Program”. In addition NASA KSC maintains a Nuclear Regulatory Commission (NRC) Broadscope Radioactive Material license, 09-11149-03 that authorizes possession and use of a wide range of radioisotopes and quantities. Under oversight of the KSC Radiation Protection Committee and it’s Chairman, the KSC Radiation Protection Officer (RPO) manages and directs the Health Physics contractor supported center-wide program to ensure worker and general public protection, compliance with the NRC license, and applicable regulations of the Department of Energy, Environmental Protection Agency, Department of Transportation, and State of Florida.

Program Structure

The KSC Radiation Protection Program is built on the following three components:

I. **Radiation Use Authorizations** - The first component is the administration of a Radiation Use Authorization (RUA) program. Under the RUA program all uses of radiation sources and radiation emitting devices must be approved. Users apply for authorization to bring and use radiation sources and emitters on KSC. This is accomplished through a Radiation Use Authorization request submitted to the Health Physics contractor by the proposed user organization. The Health Physics contractor evaluates the RUA submittal looking at intended use, applicable source/emitter operating procedures, desired location, user qualifications and training, and any federal or state regulatory required licensing and documentation from the requester. The evaluation also includes performing theoretical calculations to define radiation hazard zones. Upon completion of this review by the Health Physics contractor, a formal RUA is drafted. that outlines the following:

I. Applicable personnel protective standards
II. Authorized sources and approved use/storage locations
III. Authorized user personnel
IV. Applicable customer operating procedures
V. Hazard evaluation
VI. Operational Provisions

The draft RUA is then sent to the KSC RPO for oversight review and concurrence. Upon satisfactory review by the KSC RPO, the package is forwarded to either the 45 SW RPO for review/concurrence if any of the use activity will take part on CCAFS, or directly to the Chairman of the KSC Radiation Protection Committee for final review/concurrence. Once the Chairman signs off the RUA, it is returned to the Health Physics contractor for distribution to the requester. RUA's are valid for one year and can be renewed through the above process.

II. **Surveillance Program**-The second component of the KSC Radiation Protection Program is surveillance. All RUA activities are subject to periodic audits by the Health Physics contractor to document user compliance to RUA requirements. Audits range from onsite administrative reviews that focus on posting and procedure compliance to field measurements of radiation sources/emitters. Additionally, some RUA's require quarterly source leak testing. Some radioactive material or x-ray machine users are required to wear personnel dosimetry. The Health Physics contractor distributes and collects the dosimeters monthly. Results are tracked to insure personnel exposures are in keeping with the ALARA principle and to look for any trends that might indicate a slackening in good radiation protection practices.

III. **Radiation Protection Committee** – The third component is the KSC Radiation Protection Committee. Quarterly representatives from NASA organizations center-wide, meet to review and discuss RUA activity, radiation source/emitter inventories, RPO activities, personnel radiation dosimetry results, outside agency inspection reports and any major source launch preparation activities from the previous quarter.

Major Radiological Source Missions

Major radiological Source missions like Cassini in 1997, the two Mars Exploration Rovers in 2003, and the Pluto New Horizons mission in 2006 require significant preparation and planning. KSC-1903-Plan, "Radiological Controls for Major Radiological Sources (MRS)" identifies the requirements. Payload processing and contingency planning meetings start three years in advance of spacecraft arrival. The KSC RPO leads a detailed analysis of payload processing and source integration activities to insure source security and personnel radiation protection. Everything from a formal Dose Assessment Plan (DAMP) used to estimate personnel exposures to dress rehearsals is employed to minimize worker exposures. The KSC RPO in conjunction with a KSC appointed Coordinating Agency Representative (CAR) conduct contingency planning meetings with the Department of Energy, Air Force, KSC, and State & county officials to outline what onsite and offsite monitoring capabilities are needed to be in place to adequately and quickly evaluate radiological conditions following any launch anomaly. During launch countdown the KSC RPO directs a Radiological Control Center (RADCC) that controls and evaluates all onsite radiological monitoring assessment activities. The KSC RPO provides onsite radiation assessments and protection recommendations to the CAR. When there is the possibility for an offsite release, the Department of Energy, and State of Florida may set up an Advanced Launch Support Group (ALSG) to evaluate offsite radiological conditions. The CAR will combine RADCC evaluations with findings from the ALSG to issue worker and general public radiological protective action guidance.

Current Program Statistics

Radioactive material on RUA's: 2423
Radio Frequency Radiation sources on RUA's: 312
Laser/Optical sources on RUA's: 456
Personnel on Radiation Dosimetry Program: 78
Abnormal Radiation Exposures: 0
Federal & State Inspections: 0 discrepancies noted

Staffing

KSC Radiation Protection Officer

- Civil Service Health Physicist – Randall Scott/TA-C2/7-6958

Health Physics Contract Support

- 1 Health Physics Manager – Rod Nickell/CHS 022/853-5689
- 1 Health Physics Supervisor
- 4 Health Physics Specialists

<u>Radiation Protection Program Photos</u>

Radiation Counting Lab

Radioisotope Radiography Room

Mobile Radioagraphy

X-Ray Cabinet

Diagnostic X-Ray Unit

Industrial X-Ray Room

Accelerators

Space Trash

Radioisotope Labs

Radio Frequency Testing Room

Mobile RF Radiation Emitter

Fixed RF Radiation Emitter

RF Towers

UV Lamps

Laser Laboratorys

Ground Based Laser

Laser Etching Room

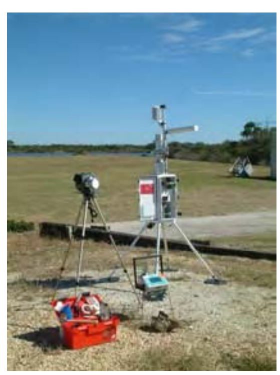
Mobile Based Laser

Measuring/Protective Equipment

Radioisotope Heater Units

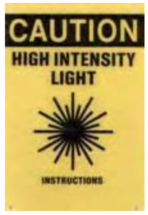
Radioisotope Power Units

Radiological Control Center



Radiological Air Sampling

Area Radiological Monitoring



Kennedy Space Center Radiation Protection Program Contacts

NASA - KSC Radiation Protection Officer:

Randall E. Scott
Mail Code TA-C2
Kennedy Space Center, FL 32899
Voice: (321) 867-6958
Fax: (321) 867-2657
E-Mail: randall.e.scott@nasa.gov

Support
Contractor - Comprehensive Health Services
Health Physics Manager:

Rodney E. Nickell
Mail Code CHS-022
Kennedy Space Center, FL 32899
Voice: (321) 853-5689
Fax: (321) 853-2887
E-Mail: rodney.nickell-1@ksc.nasa.gov

ARC HP Program:
Monitoring Radiography Operations

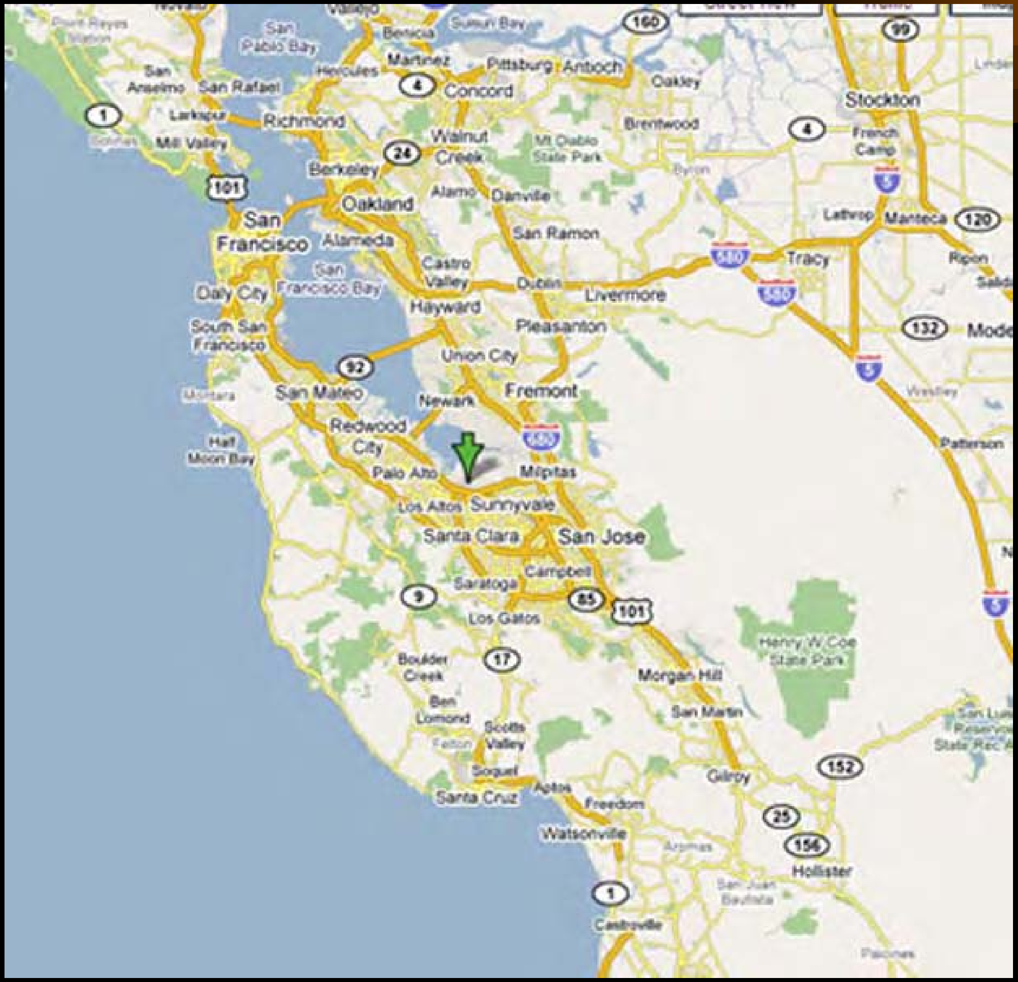
E. Packard

Ames Research Center

5/13/2008

Radiography Operations at NASA Ames Research Center

Where is NASA Ames



NASA Ames Research Center

The Main Entrance

NASA Ames Research Center

- The worlds biggest wind tunnel 80 x 120ft

NASA Ames Research Center

Right outside our office. 80x120ft wind tunnel in the background

NASA Ames Research Center

Lunar Science Institute with famous Hanger 1 in background

What we are going to cover

- Why Audit Radiography Operations???
- Common Radiography Violations
- Ames Procedures for Radiography

Why Audit Radiography Operations

Why Audit Radiography Operations

- The sources used are NRC Category 2 Sources which classifies them as a source of concern.
- Exposure to an unshielded radiography source can easily result in a dose at or over NRC limits.
- Companies differ widely as do their radiation safety practices. Some excellent and some inadequate.

Why Audit Radiography Operations

- Radiography is a competitive business, with an emphasis on productivity where safety can get lost in the pursuit of greater productivity.
- Some parties are pushing for radiography customers to be held accountable for radiography violations

Recent Radiography Violations

- **Universal Testing, LLC, UT**
  On 2/23/07, a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $6,500 was issued for a Severity Level III violation involving the failure to secure from unauthorized removal or access licensed material that was stored in an unrestricted area. Specifically, while transporting a radiography exposure device, a radiographer stopped for about 90 minutes leaving the device unattended and unsecured in the open bed of a pickup truck. Later that evening, the radiographer was involved in a traffic accident, resulting in his arrest and the impoundment of the pickup truck (with the unsecured radiography source in the bed of the truck) by the Wyoming State Police.

- **Alaska Industrial X-Ray, Inc.**
  On 10/19/07, an Order Suspending Licensed Activities was issued to Alaska Industrial X-Ray, Inc. (AIX) based on the NRC's determination that all AIX radiographers, including AIX's Radiation Safety Officer, and assistants, violated 10 CFR 34.41(a) by performing industrial radiographic operations at a temporary job site with only one qualified individual present during operations. The evidence the NRC relied on indicates that these activities have occurred on numerous occasions, for a period of up to three years. Because the NRC issued a Notice of Violation on 4/25/01, for a willful violation of 10 CFR 34.41(a) at the same client facility location, serious concerns were raised regarding AIX's willingness to comply with the Commission's requirements and its ability to conduct licensed activities without undue risk to the public's health and safety, resulting in the issuance of this order suspending all radiographic operations authorized by AIX's license.

Recent Radiography Violations

- **Western X-Ray Corporation**

  On 2/15/08, a Notice of Violation was issued for two Severity Level III violations. The first violation involved a failure to certify an individual who acted as the radiographer of record while performing industrial radiography. The second violation involved a failure to wear an operating alarm ratemeter by an individual who acted as the radiographer's assistant during radiographic operations. Specifically, on April 23, 2007, the individual acting as the radiographer of record was not certified as a radiographer and the individual acting as the assistant radiographer of record was not wearing an operating ratemeter at all times during radiographic operations, while performing industrial radiography on an offshore platform in federal waters.

- **NDT Services, Inc. PR**

  07/16/1996 Failure to retract source to the safety position during radiographic operations.

  A Notice of Violation for a Severity Level I violation was issued on 10/17/00, based on multiple failures of two former Radiation Safety Officers (RSOs) to ensure that radiation safety activities were performed in accordance with approved procedures and regulatory requirements.

NASA Ames Procedures

Duties of the Construction Contractor

- Review Health & Safety Manual Ch. 7.14 Radiography
- Submit to the Radiation Safety Office for review copies of the Radiography Companies Materials License and Radiation Safety Manual
- Submit Notification of Radiography
- Post Notices of Radiography

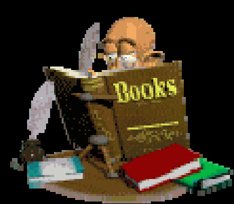
Duties of the Health Physicist

- Audit of Radiographers
- Monitor Radiation Boundaries
- File Report documenting the radiography

RSO Review of Radiographer

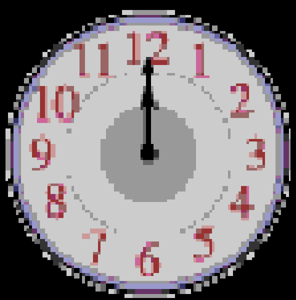
(only if company has not previously worked at Ames)

- Review State or NRC License
- Review Company Radiation Safety Manual
- Evaluate company safety record
- Keep a copy on file in the radiation saftey office



Notification Of Radiography

- Needs to be submitted to the radiation safety office at least 48 hours prior to the intended date of radiography
- Describes affected areas, scope of work radiography company, source, and strength



Notification Of Radiography

NOTIFICATION OF RADIOGRAPHY

WORK LOCATION: ______________________________

RADIOGRAPHIC CONTRACTOR: ______________________________

NASA CONTACT: ____________________ EXT: ____________

DATES, FROM: ____________________ TO: ____________

RADIOISOTOPE/kVp: ____________________ CURIES: ____________

SCOPE OF WORK:

____

____

____

____

____

____

BUILDINGS AFFECTED:

____

____

____

SAFETY PRECAUTION:

1) Follow Radiation Safety Program Procedure # AHB 1700-1, Chapter 7
2) Perform building walk thru and ensure that affected building(s) is evacuated.
3) Post affected component(s) or affected building(s) as a Radiation Area
4) Post watchers as necessary.

Additional Controls:

____

____

____

____

____

PROJECT
COORDINATOR: ____________________ DATE: ____________

RSO APPROVAL: ____________________ DATE: ____________

Notification Of Radiography

- Division Managers, Branch Chiefs, contractors, and other managers of any affected facility must be notified by the construction contractor to assure that any disruptions to their operations are understood.
- NASA Ames Security and Fire personnel shall also be notified

Posting of Notices

- The construction contractor Posts “Notices of Radiation Testing” prior to radiography
- Must be posted at all entrance/exits to affected facilities providing dates, times, and description of the areas that will be affected

Posting of Notices

NOTICE OF RADIATION TESTING

X-RAY EXAMINATIONS WILL BE PERFORMED ON PIPING ADJACENT TO THIS BUILDING ON THE TIME AND DATE INDICATED BELOW. DUE TO THE POTENTIAL RADIATION HAZARD, PERSONNEL EVACUATION OF THIS BUILDING WILL BE REQUIRED DURING THE TESTING.

AFFECTED BUILDINGS: ______________________________
DATE(S): ______________________________
TIME(S): ______________________________
IF YOU HAVE ANY QUESTIONS, CONTACT:
______________________________ EXT: __________

MAP

Health Physics Audit

- An audit of the radiographers is performed by a health physicist prior to commencing radiography operations

Health Physics Audit

Radiography Checklist

(To be completed for each day of radiography)

Date: ____________________ **Time:**____________________

Radiography Location:____

Radiography Contractor: ________________________ **Phone:** ____________

Construction Contractor:________________________ **Phone:**____________

NASA Contact: _________________________________ **Phone:**____________

License Information

License (Circle One): State w/ Reciprocity NRC

License #: _______________________ **Expiration:** ________________

Reciprocity Dates Scheduled (state only) From: ___/___/___ **To:** ___/___/___

Radiography Equipment

Camera Type (circle one): **X-ray** **Gamma Source**

Source Element: __________________ **Source Activity:** ____________

Approx. # of exposures ____________ **Approx. duration:** ___________

Pre-inspection Checks

Yes	No	N/A	
			Facility Safety Representative Notified
			Entrances to all affected buildings are posted with "Notices of Radiation Testing" signs
			Affected Buildings are clear of people
			Affected area is roped off with radiation barrier rope
			Radiation barrier is sufficient to provide radiation protection that is less than 2 mrem in any one-hour period

Radiographer Equipment Checks

Certified Radiographer: ______________________________

Yes	No	N/A	
			Certification (IRRSP, ASNT Level II, III)
			Self Reading Pocket Dosimeter has current calibration
			Alarming Dosimeter has current calibration
			TLD or film badge
			Survey Meter has current calibration

Radiographer Assistant: ______________________________

Yes	No	N/A	
			Self Reading Pocket Dosimeter has current calibration
			Alarming Dosimeter has current calibration
			TLD or film badge
			Survey Meter has current calibration

3rd Radiographer (if necessary): ______________________________

Yes	No	N/A	
			Self Reading Pocket Dosimeter has current calibration
			Alarming Dosimeter has current calibration
			TLD or film badge
			Survey Meter has current calibration

Health Physics Monitor(s)

Name(s): __________________________ **Survey Meter:** ___________________

____

Notes and comments

Inspector Signature

____ **Date:** _______________

Health Physics Audit

- Health Physics Staff will monitor the radiation exposure at the boundary ropes for a minimum of one source exposure

Health Physics Audit

- The Health Physics staff will remain for the duration of the radiography if…
  - The radiographer is new to Ames
  - Nature of the radiography may cause undue risk of exposure to Ames personnel (e.g. high elevation exposures, long exposure times, radiographies conducted during normal working hours
  - Continuous monitoring is deemed necessary to ensure Ames personnel safety for any other reason.

Post Inspection Report

- Following the Inspection the health physicist writes a report documenting the audit of the radiography

Conclusions

- Radiography doesn't happen that often and warrants enough of a concern that auditing is worth while
- Not overly time consuming
- Ensures the Safety of NASA personnel

Questions?

Eric Packard
Health Physicist
Consolidated Safety Services
NASA Ames Research Center
Moffett Field CA, 94035
Eric.D.Packard@nasa.gov
(650) 604-4548

MSFC HP Program:
X-Ray NDE

P. Brown

Marshall Space Flight Center

5/13/2008

MSFC HP PROGRAM

X-Ray NDE

Philip Brown, MSFC RSO

The X-Ray NDE program at MSFC is primarily performed in three separate x-ray cells located in buildings 4702, 4707, and 4711. The x-ray units range from backscatter systems, to standard x-ray systems, to a 2 MeV linear accelerator.

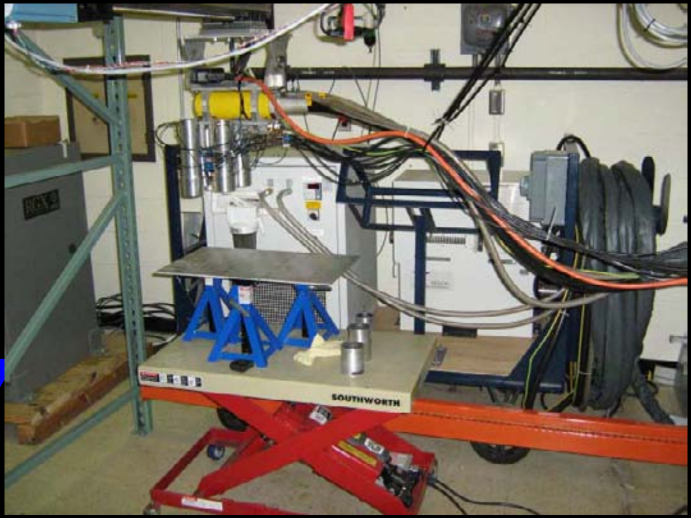
MSFC HP PROGRAM

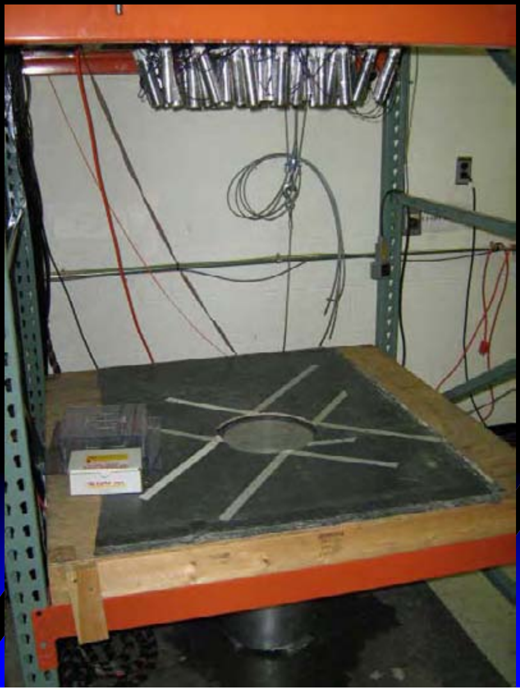
X-Ray Units

4702	Comet MXR-320/26	320keV, 4200W max	Industrial Radiography
4702	Pantak	100keV, 30mA max	Industrial Radiography
4707	Varian Linatron	2MeV linear accelerator	Computed Tomography (CT)
4707	Pantak	420keV, 5mA max	Computed Tomography (CT)
4707	Pantak	300 keV, 6 mA max	Portable Radiography Tube
4707	Tronix	150keV, 4mA max	Portable Radiography Tube
4711	Yxlon / Comet MXR 160/22	160 keV, 45 mA max	Backscatter X-Ray System
4711	Yxlon / Comet MXR 160/22	160 keV, 45 mA max	Backscatter X-Ray System
4711	Digiray	90 keV, 150 uA	Reverse X-ray System

MSFC HP PROGRAM

4711 Backscatter X-Ray Cell





MSFC HP PROGRAM

4702 Conventional X-ray Cell

MSFC HP PROGRAM

4707 Computed Tomography (CT)

Radiological Conditions/Controls Per Cell

- Backscatter lowest rad levels, Linear accelerator highest rad levels
- Backscatter requires least shielding, linear accelerator requires most
- All three have essentially the same Engineering Controls
- All three have essentially the same Administrative Controls

ENGINEERING CONTROLS:

- Cell itself, keyed console, door interlocks, emergency stops, lights/buzzers, area radiation monitors, alarming dosimetry, card readers

ADMINISTRATIVE CONTROLS:

- Site wide procedures and a specific Organizational Issuance (OI) for each cell.

- MSFC has committed to use State of Alabama Regs as a guideline

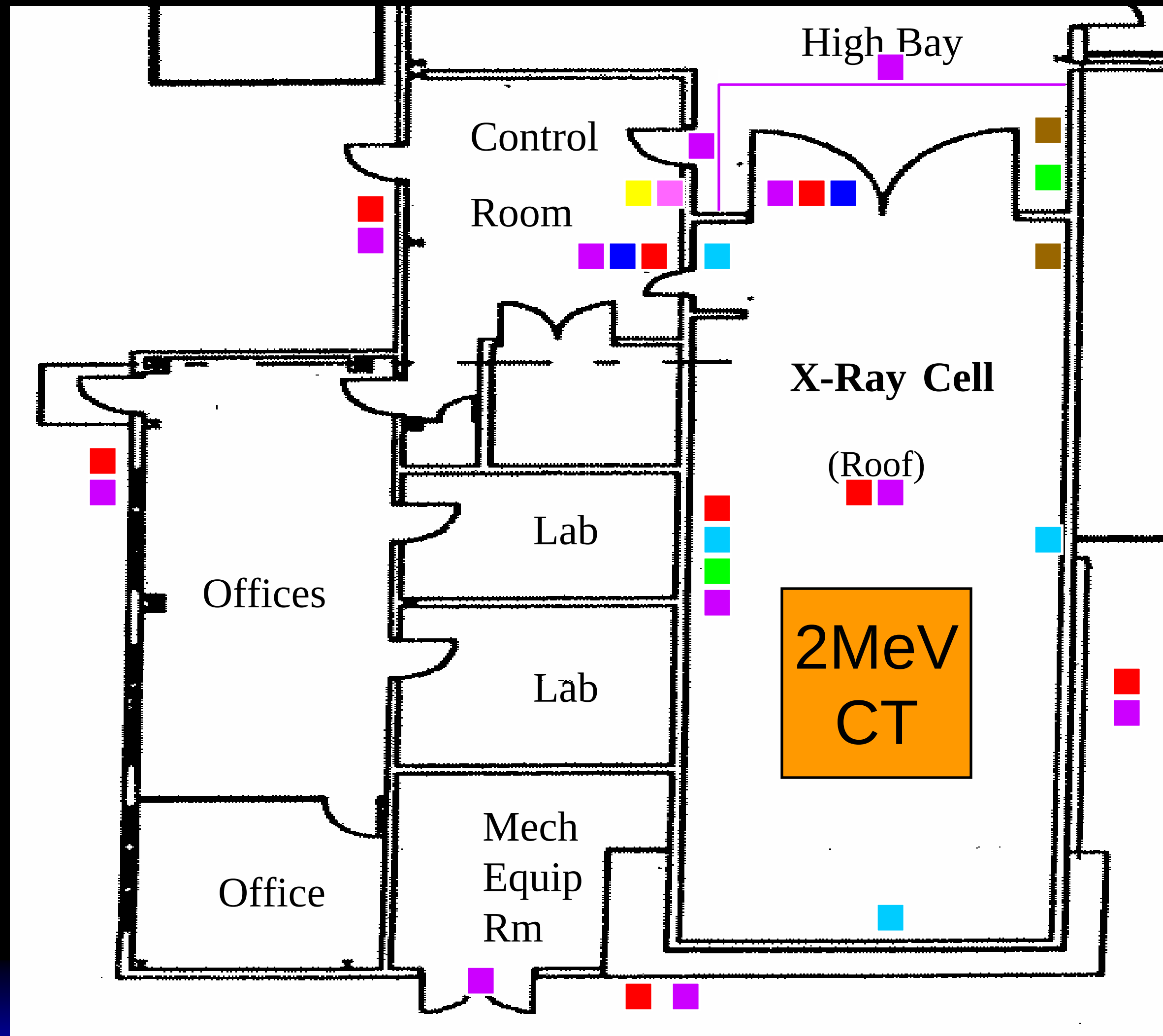
ENGINEERING CONTROLS

4707 CT Cell - Typical

MSFC HP PROGRAM

4707 X-Ray Cell

- Warning Light
- Warning Sign
- Interlock
- Cutoff
- Console
- Area Rad Monitor
- Audible Alarm
- Camera



MSFC HP PROGRAM

4707 Exterior Signs/Lights

MSFC HP PROGRAM

4707 X-Ray Cell Doors

MSFC HP PROGRAM

4707 X-Ray Cell Interior

MSFC HP PROGRAM

ADMINISTRATIVE CONTROLS

4707 X-Ray Cell - Typical

Site Wide Procedures:

MPD 1860.2, Radiation Safety Program

MPR 1860.1, MSFC Radiation Safety Procedural Requirements

MSFC HP PROGRAM

MPR 1860.1

- Training – initial and annual, computer based
- Dosimetry – TLDs provide by Army at Redstone Arsenal
- Steps for purchase and use approval, RSO/RSC approval of cell
- Specific engineering controls
- Requires user procedure that is approved by RSO
- Requires annual survey and periodic inspections by RSO

Organizational Issuances (OI)

- Separate OI For Each Cell
- Very Specific Instructions To Implement The requirements of MPR 1860.1
- Must Be Approved/Signed By RSO
- Also By Industrial Safety

4707 OI

5.3 OPERATING PROCEDURE

WARNING: At least one interlock-control door Shall remain open at all times when personnel are in the x-ray cell. Additionally, the x-ray control panel key shall be removed from the control panel and secured by a certified operator prior to entering the x-ray cell. The operator shall confirm that the x-ray cell is unoccupied prior to inserting the control panel key. Operator shall wear a TLD badge on upper torso of body at all times when operating x-ray system. At the end of the day the TLD badge shall be placed in a designated location. A certified operator shall be present at all times when the x-ray system is in the energize mode.

5.3.1 Check logbook to verify that audible and visible radiological warning system check has been performed for the current day.
5.3.2 Check logbook to verify that the safety Interlock system has been checked for the current month.
5.3.3 Check logbook to verify that emergency shutdown system has been checked for the current month.
5.3.4 Rope off corridor area near north (bay) doors.
5.3.5 Operator shall make sure x-ray beam is directed toward primary (south) wall.
5.3.6 Close north (bay) doors to the x-ray cell. Mechanical clicking shall occur to signal that interlocks have been reset.
5.3.7 Verify that vertical slide bolt is engaged on Bay doors.
5.3.8 Visibly inspect x-ray cell to make sure that no one is inside.
5.3.9 Close west door to the x-ray cell. Mechanical clicking shall occur to signal that interlocks have Been reset, and an audible buzzer shall alarm. The red light to the left of the cell door shall illuminate.

NOTE: IN THE EVENT THAT THE BUZZER DOES NOT SOUND OR THE RED LIGHT DOES NOT ILLUMINATE OPERATIONS SHALL BE IMMEDIATELY SUSPENDED AND THE RSO AND NDE TEAM OR BRANCH CHIEF SHALL BE NOTIFIED.

5.3.10 Verify that no unauthorized personnel are in the control room.
5.3.11 Perform computed tomography inspection Per operator instructions in the ACTIS 2000 or Hytec FlashCT operator's manual.

MSFC HP PROGRAM

4707 OI

6.1 OPERATIONS

6.1.1 Two Certified Operators are required for operation of the linear accelerator; one Certified Operator is required for operation of the x-ray tube.

6.1.2 Prior to operation of the facility, tests of the safety interlock switches, manual emergency shutdown switches and audible and visible radiological warning signals, as outlined in Section 7, shall be performed.

6.1.3 Checks of the audible and visible radiological warning signals shall be performed and logged daily, prior to the first operation of the day.

6.1.4 Checks of the interlock switches and manual emergency shutdown switches shall be performed and logged monthly.

6.1.5 Additional safety checks may be performed at the discretion of the certified operator or as directed by the Team Lead or Branch Chief or the Radiation Safety Officer.

6.1.6 Safety checks are not required on days when the system is not operated.

MSFC HP PROGRAM

4707 OI

7.2.5 RADIATION MONITORING DEVICES - Survey meters are used to monitor the control room, the inside hallway of building 4707, and the adjacent office area during inspection operations. Meters shall be calibrated every six months. Area surveys of the facility, including the control room, adjacent office areas, and surrounding areas including the area outside the large double doors and outside the CT facility, shall be conducted by EM20 every three months. Radiation monitoring records shall be maintained for a period of three years to assure that proper shielding has been provided.

7.2.6 SURVEILLANCE SYSTEMS - Video surveillance units are used to monitor the exposure bay and the inside hallway of building 4707. The surveillance systems are also used to verify that no unauthorized personnel are in the exposure area prior to operation of the x-ray unit. Surveillance, in the form of a walk through and visual inspection of the x-ray cell shall be used to verify that no personnel are in the exposure area prior to operation of the x-ray unit. If the operator observes any person entering the exposure bay during operation of the x-ray unit, he shall immediately cease operation of the x-ray system and notify the RSO and the NDE Team Lead or Branch Chief.

MSFC HP PROGRAM

4707 OI

7.3 PERSONNEL MONITORING

7.3.1 DOSIMETRY - The monitoring of personnel exposure to radiation shall be accomplished by employing thermoluminescent dosimeter (TLD) badges. The TLD badges are checked quarterly to monitor x-ray dosage.

7.3.2 TLDs shall be carried by the operators only while in the computed tomography facility.

7.3.3 Personal alarming dosimeters shall also be worn by operators.

7.5 PERSONNEL CONTROL

7.5.1 At least two certified operators shall be present at all times during linear accelerator operations; at least one certified operator shall be present at all times during x-ray tube operations.

7.5.2 Access control is achieved through the use of an electronic badge reader with a restricted access list. Entrance to the south mechanical equipment room is controlled by storage of the key to that room in the computed tomography facility.

7.5.3 All other NDE operations not requiring x-rays shall be performed outside the computed tomography facility.

4707 OI

Appendix C: Procedure for Functional Check of Safety Interlock System

1. Perform walkthrough of x-ray cell to ensure that no personnel are inside.
2. Close north x-ray cell doors (bay).
3. Close west x-ray cell door as completely as possible without contacting the interlock safety switch.
4. Independently, attempt to energize each x-ray unit.
5. The x-ray unit should not energize. If the x-ray unit does energize, immediately turn the x-ray unit off, suspend operations of the x-ray unit, notify the RSO and NDE Team Lead or Branch Chief and submit a work order to have the interlock system repaired. Operation of the system shall be suspended until approval is obtained from the RSO and Team Lead.
6. Perform walkthrough of x-ray cell to ensure that no personnel are inside.
7. Close one of the north x-ray cell doors (bay) as completely as possible without contacting the interlock safety switch. The other door shall be closed completely.
8. Post a monitor at the north x-ray cell doors to prevent inadvertent entry into the x-ray cell.
9. Close the west x-ray cell door.
10. Independently, attempt to energize each x-ray unit.
11. The x-ray unit shall not energize. If the x-ray unit does energize, immediately turn the x-ray unit off, suspend operations of the x-ray unit, notify the RSO and NDE Team Lead or Branch Chief and submit a work order to have the interlock system repaired. Operation of the system shall be suspended until approval is obtained from the RSO and Team Lead.
12. Repeat steps 6 through 11 for the other bay door.
13. Record interlock tests in the Interlock Test Logbook.

MSFC HP PROGRAM

4707 OI

Appendix D: Procedure for Functional Check of Manual Emergency Shutdown Safety Switches

1. Perform walkthrough of x-ray cell to ensure that no personnel are inside.
2. Close north x-ray cell doors (bay).
3. Depress a single emergency shut down switch.
4. Exit bay and close west x-ray cell door completely.
5. Independently, attempt to energize each x-ray unit.
6. The x-ray unit shall not energize. If the x-ray unit does energize, immediately turn the x-ray unit off, suspend operations of the x-ray unit, notify the RSO and the NDE Team Lead or Branch Chief and submit a work order to have the emergency safety switch repaired. Operation of the system shall be suspended until approval is obtained from the RSO and Team Lead.
7. Manually reset emergency shutdown switch.
8. Repeat steps 1 through 7 until each of the emergency shut down switches has been independently tested.
9. Record emergency shutdown switch test in the Manual Emergency Shutdown System Test Logbook.

MSFC HP PROGRAM
4707 OI

Appendix E: Procedure for Check of Audible and Visible Radiological Warning Systems

1. Verify that the Pantak interlock bypass plug is secured in the lockbox on the west wall of room 136.
2. Verify visible radiological hazard warning signs are in place as follows:
Interior x-ray control room east wall, adjacent to x-ray cell door.
Exterior x-ray cell bay doors (one sign on each door).
Exterior west wall (two signs, one at each entry).
Exterior east wall.
Exterior south wall.
Roof.
2. Verify that no personnel are inside mechanical control room and that mechanical control room is locked.
3. Verify that no one is on the roof of the x-ray cell.
4. Perform walkthrough of x-ray cell to ensure that no personnel are inside.
5. Close north x-ray cell door.
6. Close west x-ray cell door.
7. Verify that audible buzzer is operational.
8. Verify that red light in control room is on.
9. Verify that red strobe lights are functioning as follows:
Exterior east wall.
Exterior north x-ray cell door (bay).
Exterior south wall mechanical control room above door.
Exterior south wall.
Roof.
9. In the event that any of the audible and visible warning signals are not in place or are not operating properly the x-ray unit shall not be placed in operation. The NDE Team Lead shall be notified immediately and a work request shall be initiated to repair the system. Operation of the system shall be suspended until approval is obtained from the NDE Team Lead and RSO.
10.Record audible and visible radiological warning sign check in Audible and Visible Radiological Warning System Check Logbook.

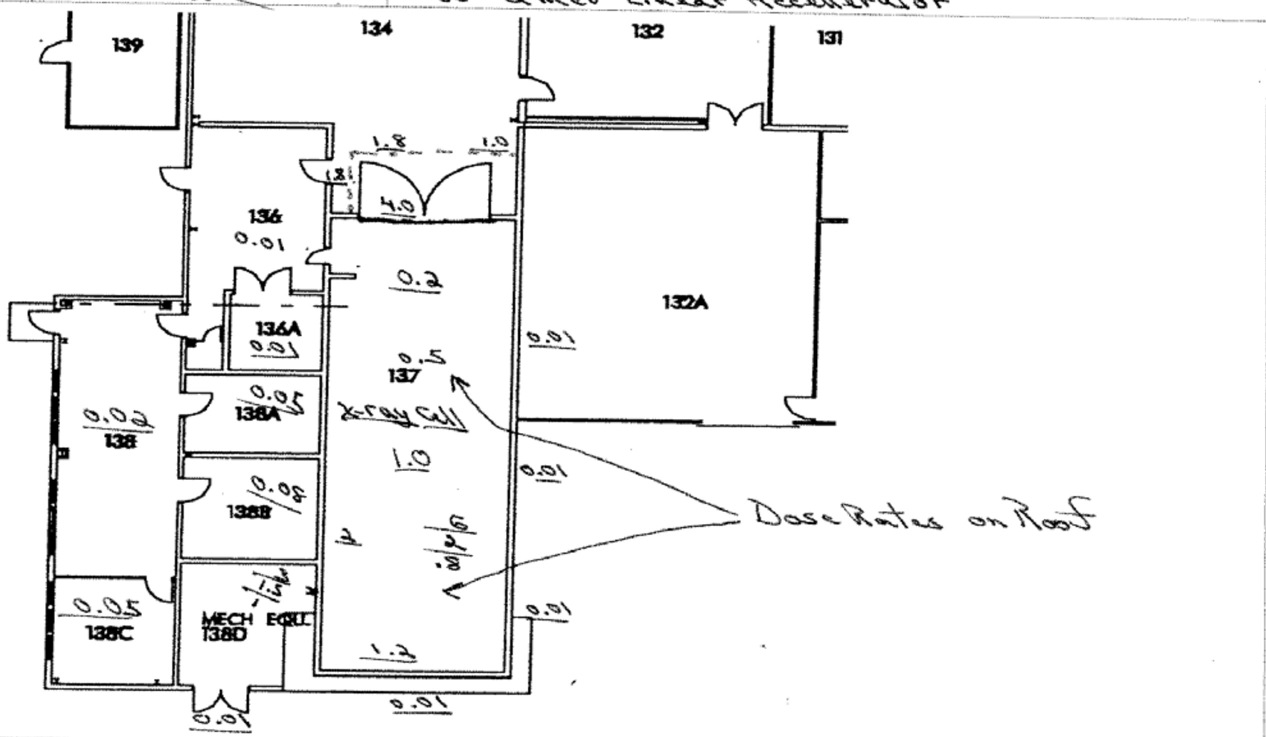
MSFC HP PROGRAM

4707 CT X-Ray Cell Survey

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Radiological Survey Map

Date:	Time:	Performed by: (Print/Sign)	Description:
8.6.07	1400	Philip Brown	Survey of 4707 x-ray cell during operation of 2MeV Linear Accelerator

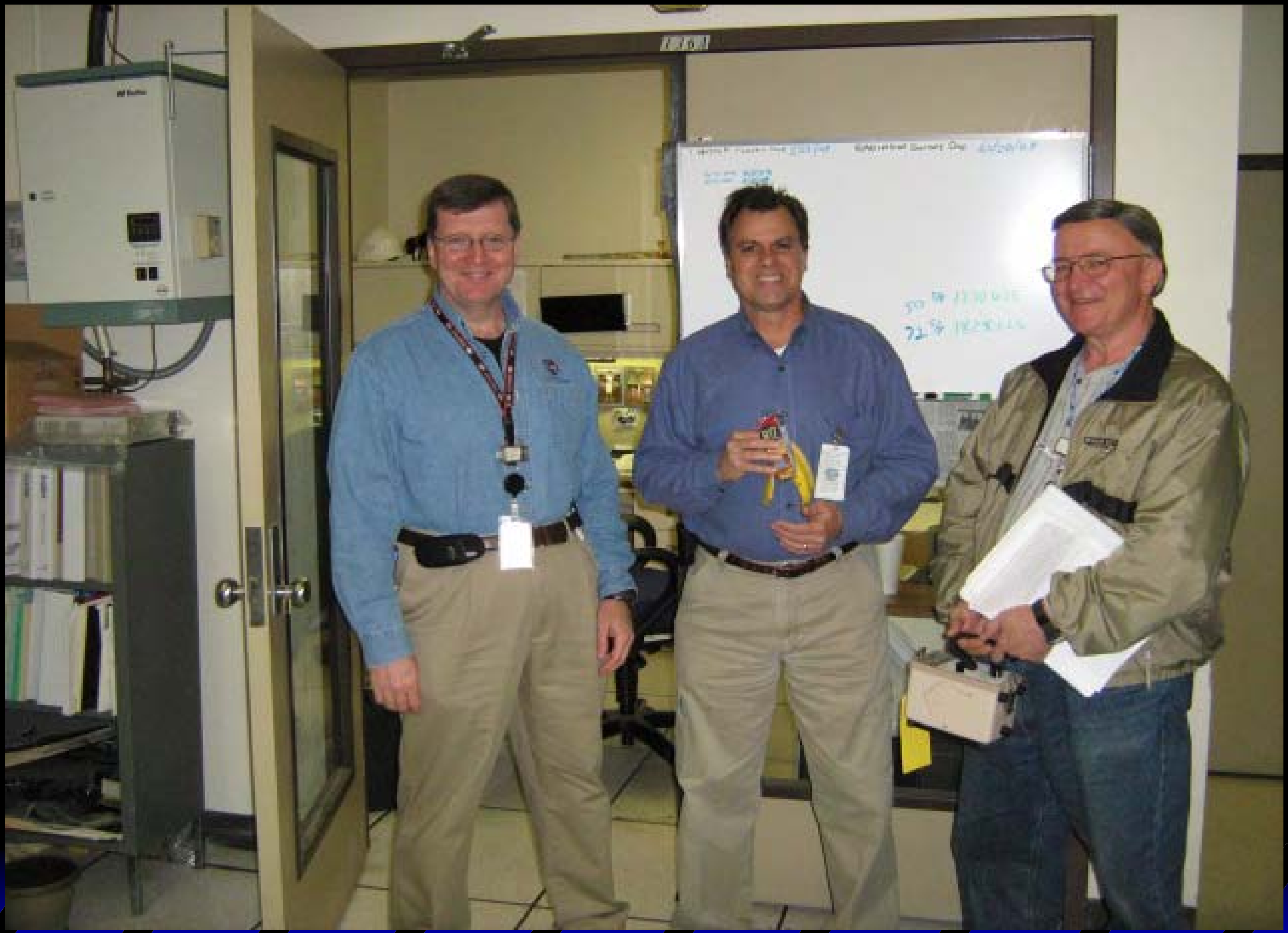


Dose Rate Instrument	Contamination Instrument		Comments
Serial Number	Type	Serial Number	All dose rates in mrem/hr
MicroRem AOLE 1883	N/A		Annual Survey

MSFC Form 4486 (Rev. June 2007)

MSFC HP PROGRAM

Effects of Prolonged exposure to Low Level Radiation



MAF ALARA Program: X-Ray NDE

A. Rovira

Michoud Assembly Facility

5/13/2008

NASA Health Physics Conference

MAF ALARA Program
X-Ray NDE

Alan J. Rovira
Senior Industrial Hygienist

- **Three Types of X-Ray NDE Testing at the Michoud Assembly Facility**
  - **Film**
  - **Digital**
  - **Backscatter**

- **ALARA Program**
  - **Certify the exposure levels at the barriers are less than 2 mR/hr**
  - **All personnel performing radiography radiographic operations shall wear an alarming rate meter (500 mR/hr), a pocket dosimeter and a TLD badge.**
  - **Pocket dosimeter reading will be recorded at the beginning of each radiography operation and at the end of each work shift.**
  - **If the pocket dosimeter indicator goes off scale or records a dose at or above 200 millirems during a work operation, the wearer will notify supervision immediately.**

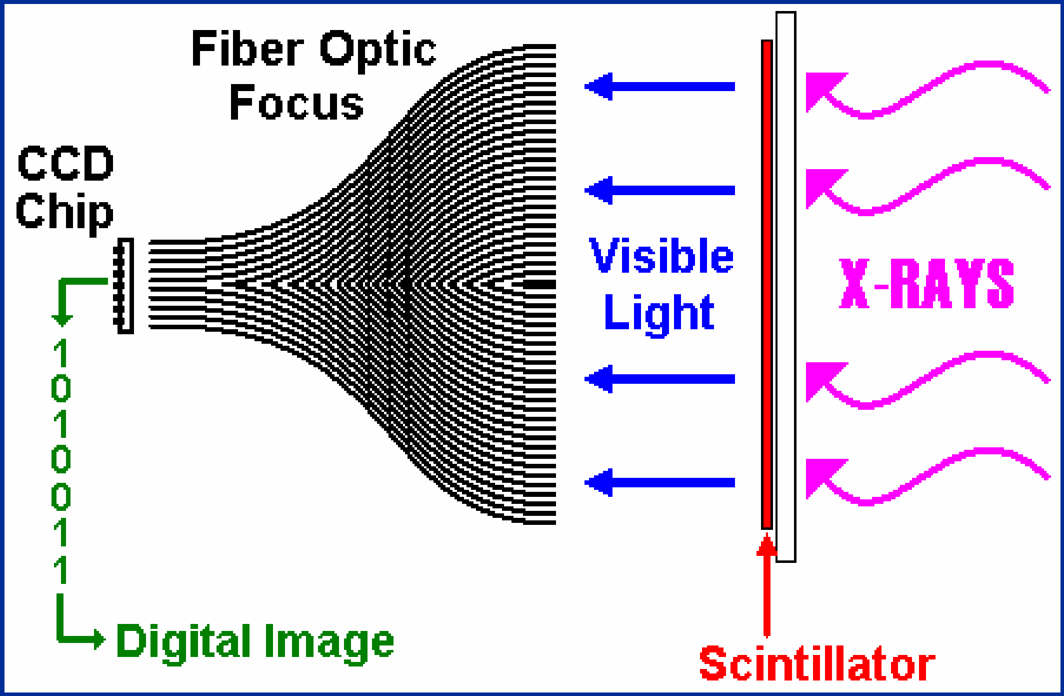
Digital X-ray

Traditional Film X-ray Method

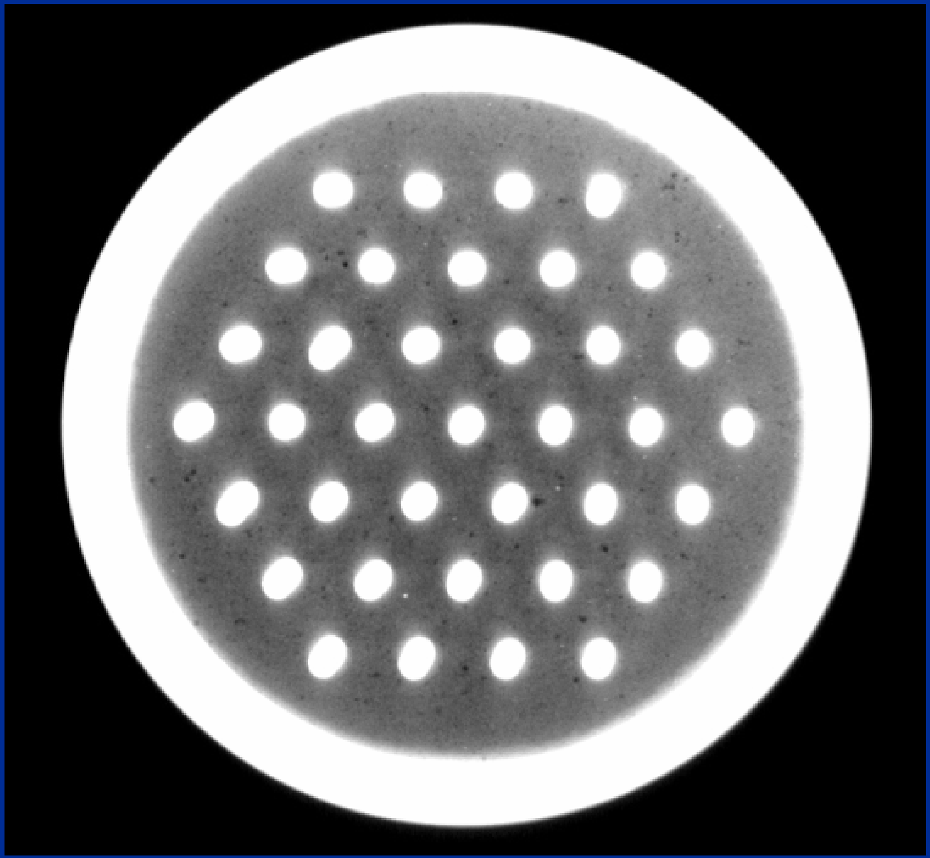
- Uses sheet film, chemicals and developer to produce a viewable image.

Digital X-ray Method

- Uses a scintillator plate to convert x-rays to visible light which is focused onto a Charged Couple Device (CCD) that outputs a digital image.



ET-125 Digital Radiographic NDE Assessment



Air voids throughout image inherent to part

81L2-2 Feedthrough Standard

Lot No. 9934A

Digital X-ray

Benefits:

Increased Safety/Reliability :

- **Digital radiography eliminates safety or environmental concerns from hazardous chemicals used to develop film**
- **Digital storage prevents loss of irreplaceable films**

Cost Reduction :

- **Digital radiography eliminates the expense of film and developer**
- **Image is available for interpretation in less time**
- **Process lends itself to automation for overall NDE time reduction**

Conclusion:

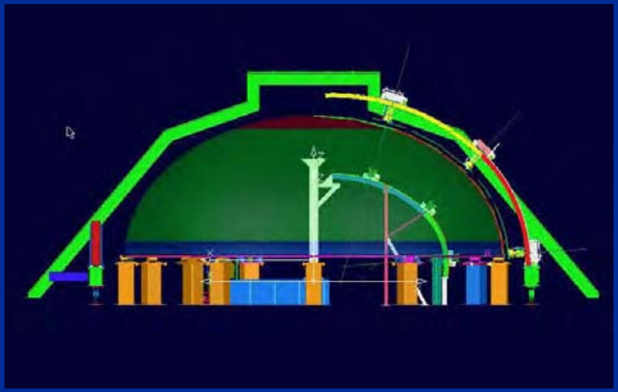
Digital radiography saves time and money while providing a safer and more reliable product.

Digital X-ray

5017 T-ring Tooling

Status: Installed on tool

5354 Dome Tooling



Status: In fabrication

Backscatter - ET-121 TPS NDE

BSX Head on Scanner

Scanning Table Configured for
ET Inspection

TPS NDE Background

At the time of the Columbia accident, there were no Thermal Protection System (TPS) Non-Destructive Evaluation (NDE) methods available for Spray-On Foam Insulation (SOFI) and pour foam inspection. Development efforts in this area had been pursued at the Michoud Assembly Facility (MAF) and other National Aeronautics and Space Administration (NASA) centers from the early 1980s to the early 1990s, but with no success. As a practical matter, inspection of low-density plastic type materials does not represent a large part of the NDE market. These materials are inexpensive and generally considered disposable. If a builder spraying insulating foam similar to that used on the External Tank (ET) experiences a problem with the spray, he simply strips off the suspect material and discards it. Small voids or other defects are not a major concern, because the material is not used for any structural purpose. The nature of TPS materials and how they are used on the ET program has required development of non-traditional NDE methods to solve this inspection problem.

Backscatter Radiography Background

• Backscatter Radiography is an inspection method that involves exposing a part to x-rays and collecting the x-rays that are ‘scattered’ back from the part.

• The collected x-rays are actually secondary x-rays generated by interaction between the incident x-ray beam and the material that it passes through. This is Compton Scattering, in which the incident x-rays are absorbed by the atoms in the part and then re-emitted as lower energy x-rays.

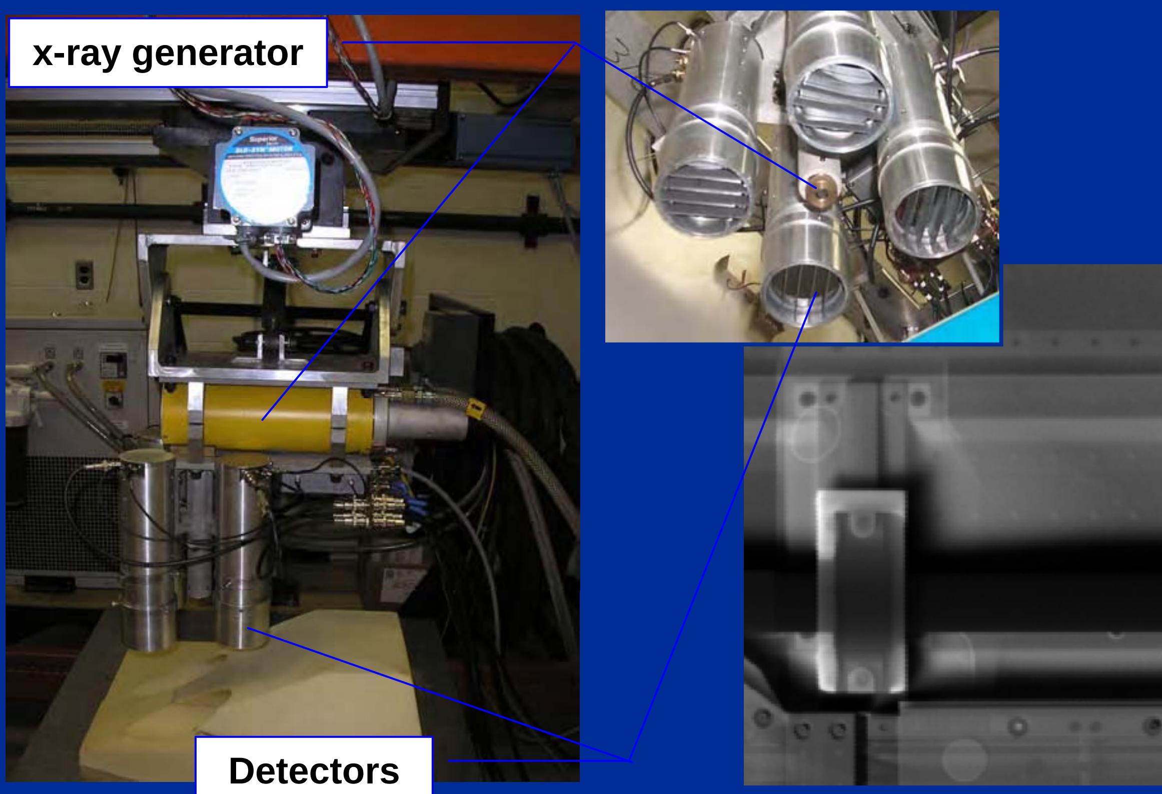
• Backscatter Radiography provides similar contrast images to transmission radiography but only requires access to one side of the part. This characteristic and the ability to penetrate the relatively low-density foam material make Backscatter Radiography an effective inspection method for TPS NDE

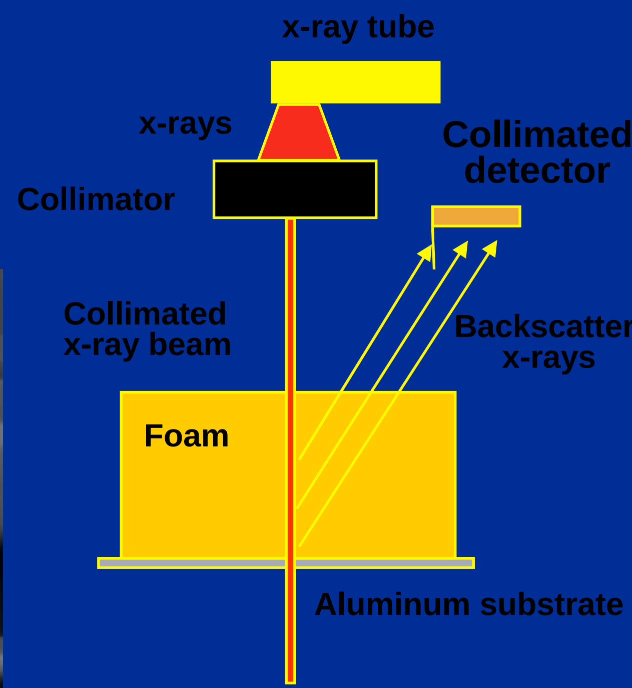
•A standard industrial x-ray tube is used to generate x-rays that are then collimated into a narrow beam. The MAF system has an adjustable beam diameter, which is typically set to 0.1 inch. As the collimated beam passes through the foam it produces backscatter x-rays that strike the detector. Differences in backscatter x-ray density are produced when the beam travels over a void or other defect.

• The system is mounted on an x-y scanner that can cover a 2-foot by 2-foot area.

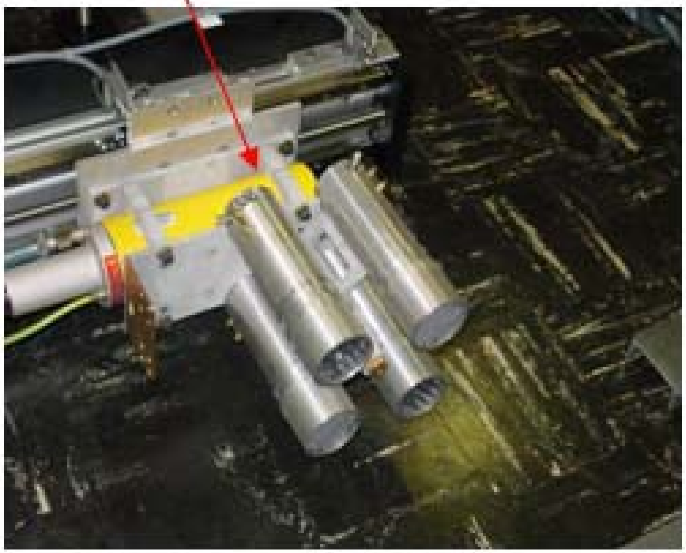
BACKSCATTER RADIOGRAPHY

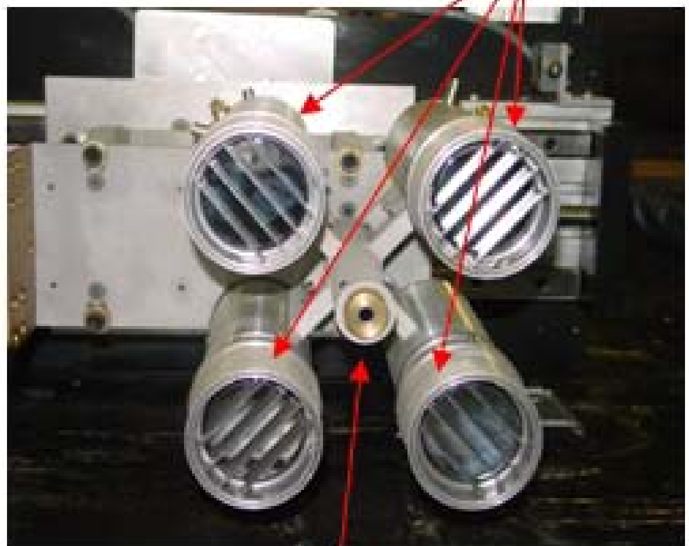
- Collimated beam of x-rays interact with sample molecules
- Backscatter x-rays are emitted (Compton Scattering), possibly after multiple subsequent scattering events, and detected by collimated detectors
- The collimated detectors provide some preferential sensitivity to selected depth
- The x-ray beam and detectors are scanned across the part to generate a 2-D presentation of the internal make-up of the foam. 1 sq foot per hour





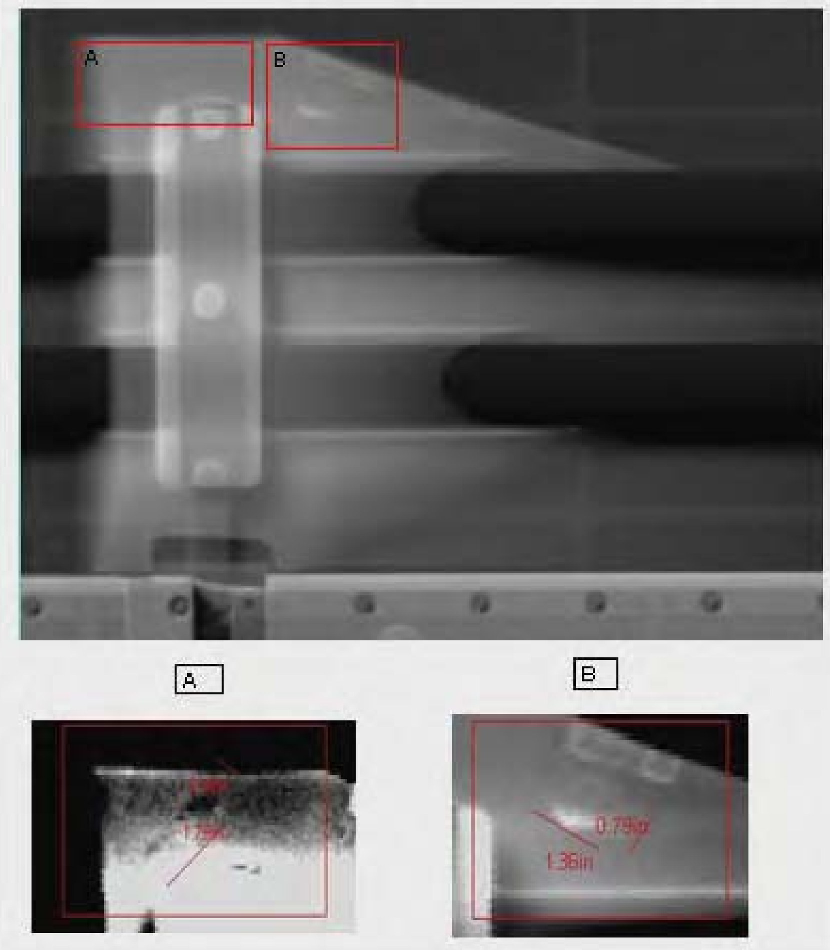
BSX Image


Backscatter instrument

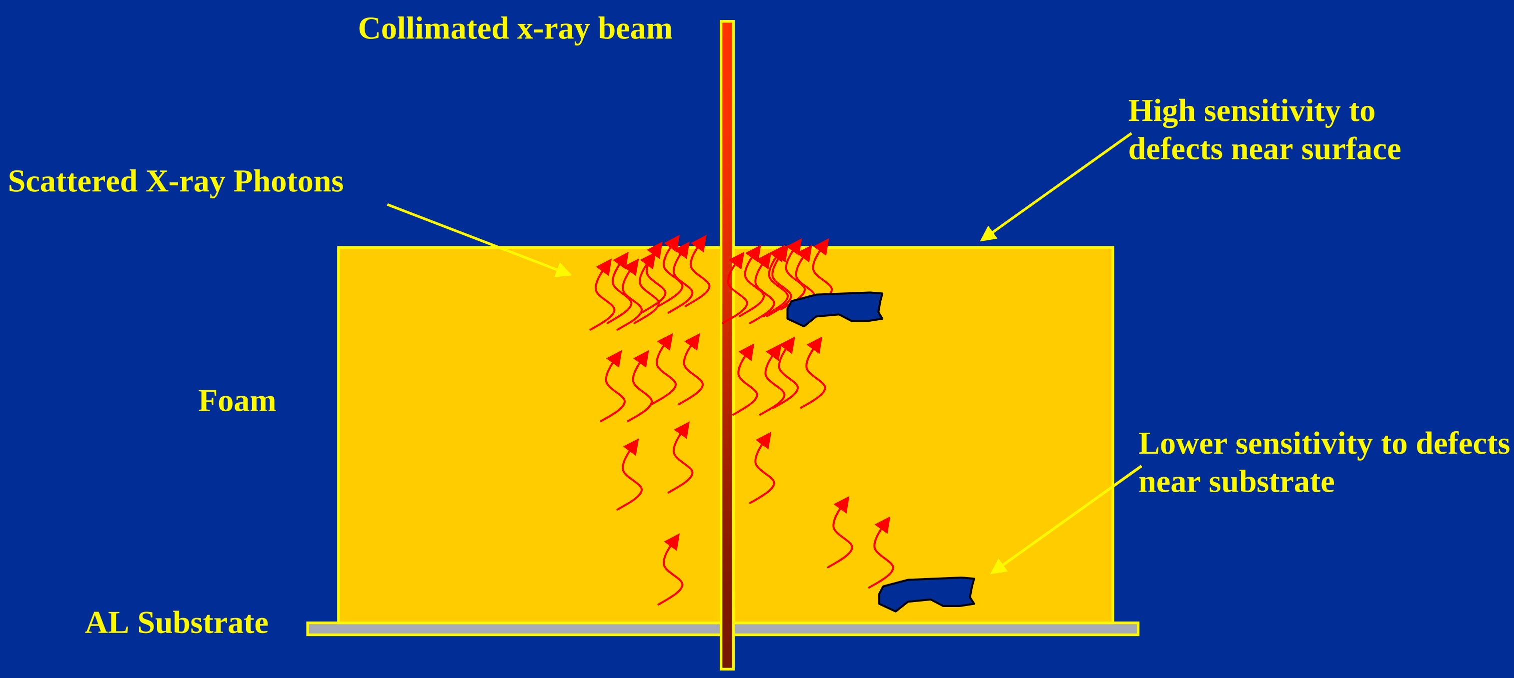

Detectors with collimators
Beam collimator

ET123 IFR Indications

- ***Station 1657***
  - *Linear indication*
  - (A) 1.79”X, .48”Y
  - *Area More Dense*
  - (B) 1.36”X, .79”Y



- Backscatter theory of operation
  - Typical x-ray energy for foam is 55 kV
  - Foam attenuates incident x-rays so intensity drops with depth
  - Scattered photons are scattered or absorbed by the foam so those that originated deeper are less likely to reach the detector



Michoud Assembly Facility

MAF Transition

MAF Transition
NASA Direction and Intent

- NASA has made a strategic decision to transform MAF into a NASA facility that supports multiple programs
- To implement this NASA decision, MSFC created the MAF Transition Office to plan and manage the transformation, and define and implement a new business model
- Retain the MAF incumbent workforce to the maximum extent possible:
  - Experienced employees
  - Familiarity with MAF
  - Familiarity with NASA/MSFC policy and procedures

NASA Michoud Long Term Commitment

NASA Administrator Michael Griffin

"We are counting on you to continue providing the shuttle external tanks that will enable us to complete the space station and prepare for the next great era of space exploration. And we will rely on you to be at the forefront of this epic era, producing the tanks that will enable our Crew Exploration Vehicles and Heavy Lift Launch Vehicles to send our astronauts to the Moon, Mars and beyond." *January 2006*

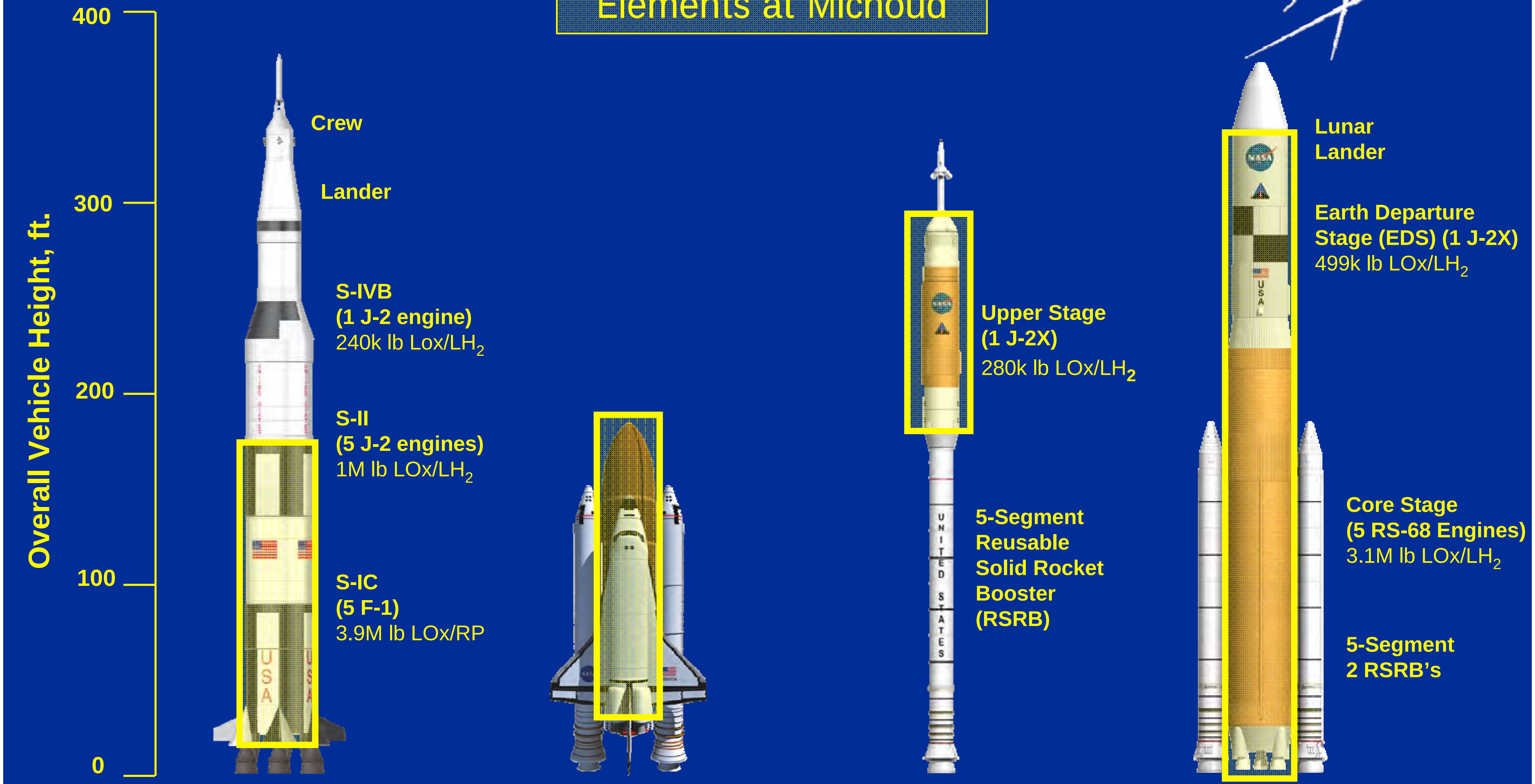
NASA Constellation Management

"This is going to be the largest rocket in history……We are going to fill up that plant down at Michoud to manufacture it…"
April 2007, Constellation Program Manager, Mr. Jeff Hanley

http://www.nasa.gov/mission_pages/constellation/main/index.html

Yesterday, Today, and Tomorrow

Elements at Michoud



Saturn V
Height: 364 ft
Gross Liftoff Mass:
6.5M lb

Space Shuttle
Height: 184.2 ft
Gross Liftoff Mass:
4.5M lb

Ares I
Height: 321 ft
Gross Liftoff Mass:
2.0M lb

Ares V
Height: 358 ft
Gross Liftoff Mass:
7.3M lb

MAF- Orion Capsule -Lockheed Martin

MAF – Upper Stage - Boeing

- NASA’s Michoud Assembly Facility in New Orleans, will manufacture the Orion capsule manufacture and assemble the Ares I upper stage

NASA/Marshall Space Flight Center (MSFC)
Michoud Assembly Facility (MAF)

NASA
Michoud Assembly Facility

Investment in the Future
- Advanced World-Calss Manufacturing Facilities
- Attract Private Sector Research, Design and Manufacturing
- Collaborative Partnership with State of Louisiana, Private Industry, and Academia
- Highly Skilled Workforce
- Provide Future Growth Opportunities for the Region
- Enhance and Reinforce NASA Core Mission Objectives
- Permanent U.S. Coast Guard Installation

Facility Enhancements
- New NASA / MAF Administrative Headquarters
- New Advanced Technology Research Park
- Improved / Expanded Employee Recreation Amenities
- New Fire Station Serving MAF and Surrounding Community
- Improved Facility Security Infrastructure
- Improved Pumping Station to Enhance Flood Control
- Phased Future Private Sector Development Areas

New Gate 5 Complex
- Main Security Gate
- Fire Station Serving MAF and Local Community
- Service Station and Store
- Outdoor Employee Recreation Area
- Walking Track and Pavilion

paradigm

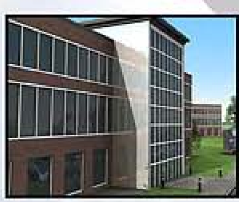
Creating a better life by design.

BWSC

NASA
Michoud Assembly Facility

New Advanced Technology Research Park

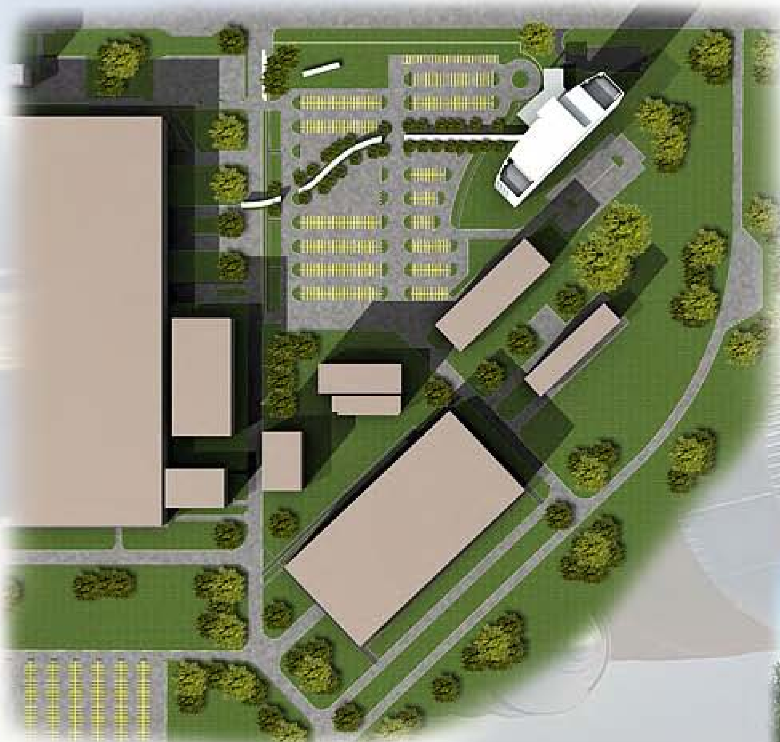
- Utilization of Underutilized Green Space
- 168,000 sq.ft. Total Floor Area
- Four 42,000 sq.ft., 3-Story Buildings
- Campus-type Setting
- Enhanced Use Lease Facilities to Attract Private Sector Companies
- Potential Location for both Industry and Academia



NASA
Michoud Assembly Facility

New Administrative Headquarters

- 160,000 sq.ft., 5 stories
- Top-Level Conference and Training Center
- NASA Resident Offices
- NCAM Offices and Conference Areas
- New Space Flight Hardware Exterior Static Display
- Expanded Gate 11 Entrance Facilities



paradigm

Creating a better life by design.

BWSC Barge Waggoner Sumner & Cannon, Inc.

GRC HP Program: Decommissioning Experiences

R. Case and C. Blasio

Glenn Research Center

5/13/2008


Plum Brook Reactor Facility
5/17/05

NASA Glenn Research Center
Plum Brook Reactor Facility
Decommissioning Overview

Rod Case - Decommissioning Project, Asst. RSO

Plum Brook Reactor Facility History

- The Plum Brook Reactor Facility (PBRF) consisted of a 60 MW main reactor, a 100 KW Mock Up reactor, seven hot cells for metallurgical analysis of irradiated material, and several support structures.
- The facility was used to perform basic research into the effects of neutron radiation on materials intended for use in the nuclear rocket programs (NERVA, ROVER)
- 1958 – Construction Begins
- 1961 – Initial Criticality
- 1963 – 1973 – Full power operations

PBRF History – Shutdown to Decommissioning

- 1973 – With the termination of the nuclear rocket program the decision was made to shut down the PBRF
- 1973 – Between January and June of this year the facility was placed in a 'Safe, Dry Storage' condition; all fuel was shipped from the site
- 1997 – NASA decided to proceed with decommissioning of the PBRF

What is Decommissioning?

- Decommissioning is the process of cleaning up a reactor site to a level that allows unrestricted release of the NRC license.
  - Contaminated and activated equipment is removed
  - Remaining building surfaces and open land areas are cleaned to below the levels specified in the Final Status Survey Plan
  - After clean up (decontamination) an extensive effort is made to survey and document that all areas are in fact clean (below the Derived Concentration Guide Lines – DCGLs)
  - NRC independently verifies the above actions are complete, then terminates the facility license.

Decommissioning End State

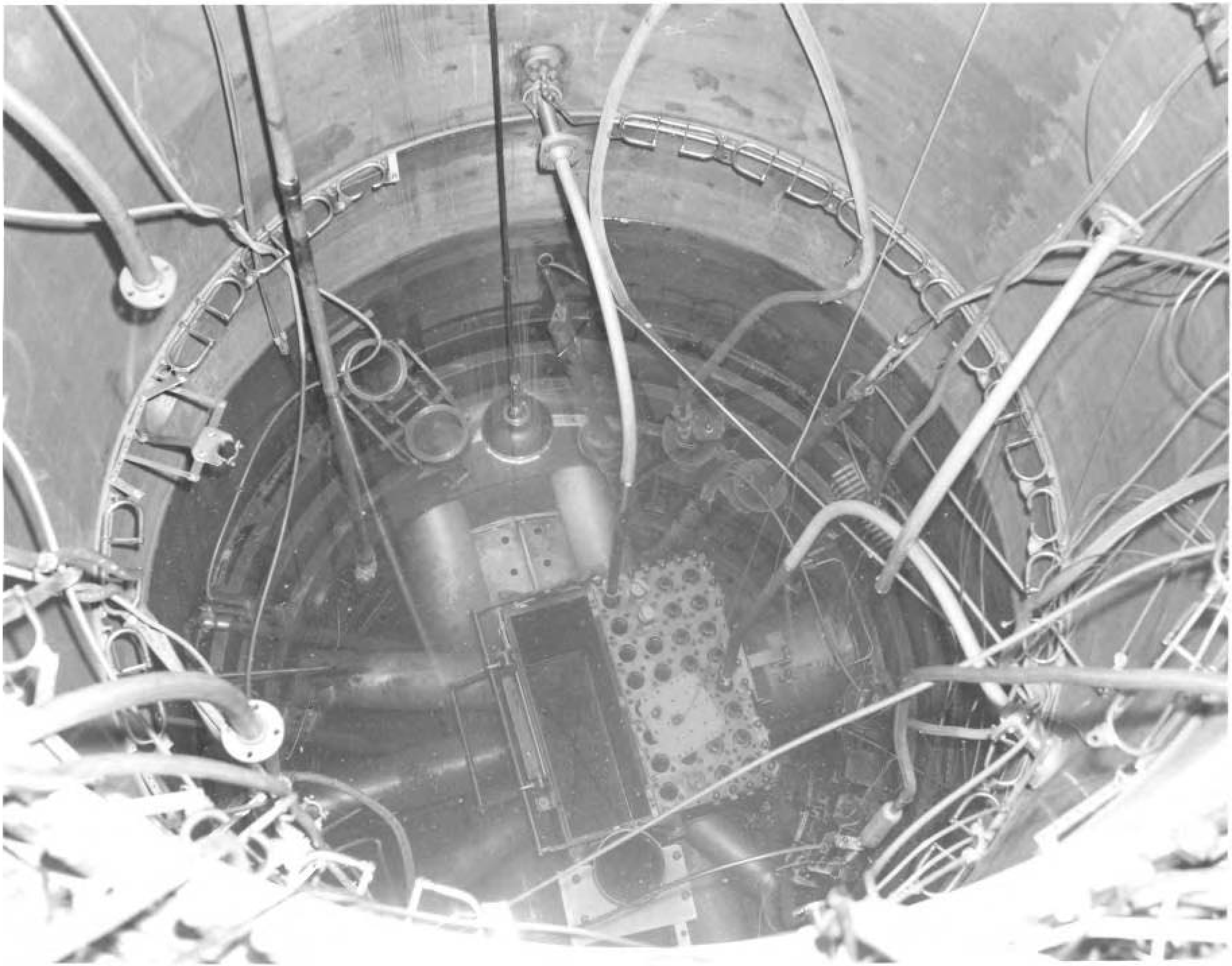
- The end state will be an open, green field.
  - Following license termination all structures will be demolished to 3’ below grade.
  - All remaining subgrade areas filled with clean, hard fill to -3’, then topped off with soil
  - No future monitoring will be required
  - The land will remain part of the buffer zone for the rest of Plum Brook Station.
- DCGLs are low enough that a family could come to live on the site as farmers and still be safe.

Timeline

- 1997 NASA decides to decommission
- 1999 NASA submits D-Plan to NRC, begins pre-decommissioning work
- 2002 NRC approves D-Plan, NASA begins decommissioning in full
- 2004 NASA submits Final Status Survey Plan to NRC (approved in March 2008)
- 2010 Estimate for completion of field work
- 2011 Estimate for license termination and site restoration

Where are we now?

- More than 99% of the source term has been safely removed, and all buildings are empty.
- Both reactors and control rooms are gone.
- 18 million pounds of Low Level Rad Waste have been shipped offsite for disposal
- 1.1 million pounds of metal and 0.8 million pounds of concrete have been salvaged for recycling
- Decontamination complete in nearly all structures except the Reactor Building
- Over three miles of embedded piping has been cleaned and surveyed.
- FSS completed in 40% of the building interiors



Reactor Segmentation

Late 2003

Reactor Lid

Control Rod

Shrapnel Shield

Beryllium Plate

Reactor Segmentation

Early 2004

Removing core box

Inside view

Core box at cutting station

Reactor Segmentation

Spring/Summer 2004


Flow guide


Metering plate


Thermal shield


Shrapnel shield


Thermal column


11/12/04




Hot Lab area after loose equipment removal

Fixed Equipment Removal

Reactor Building

Before

During

After

Fixed Equipment Removal

Before

Service Equipment Building

After

During

Fixed Equipment Removal

Waste Handling Building

Before

During

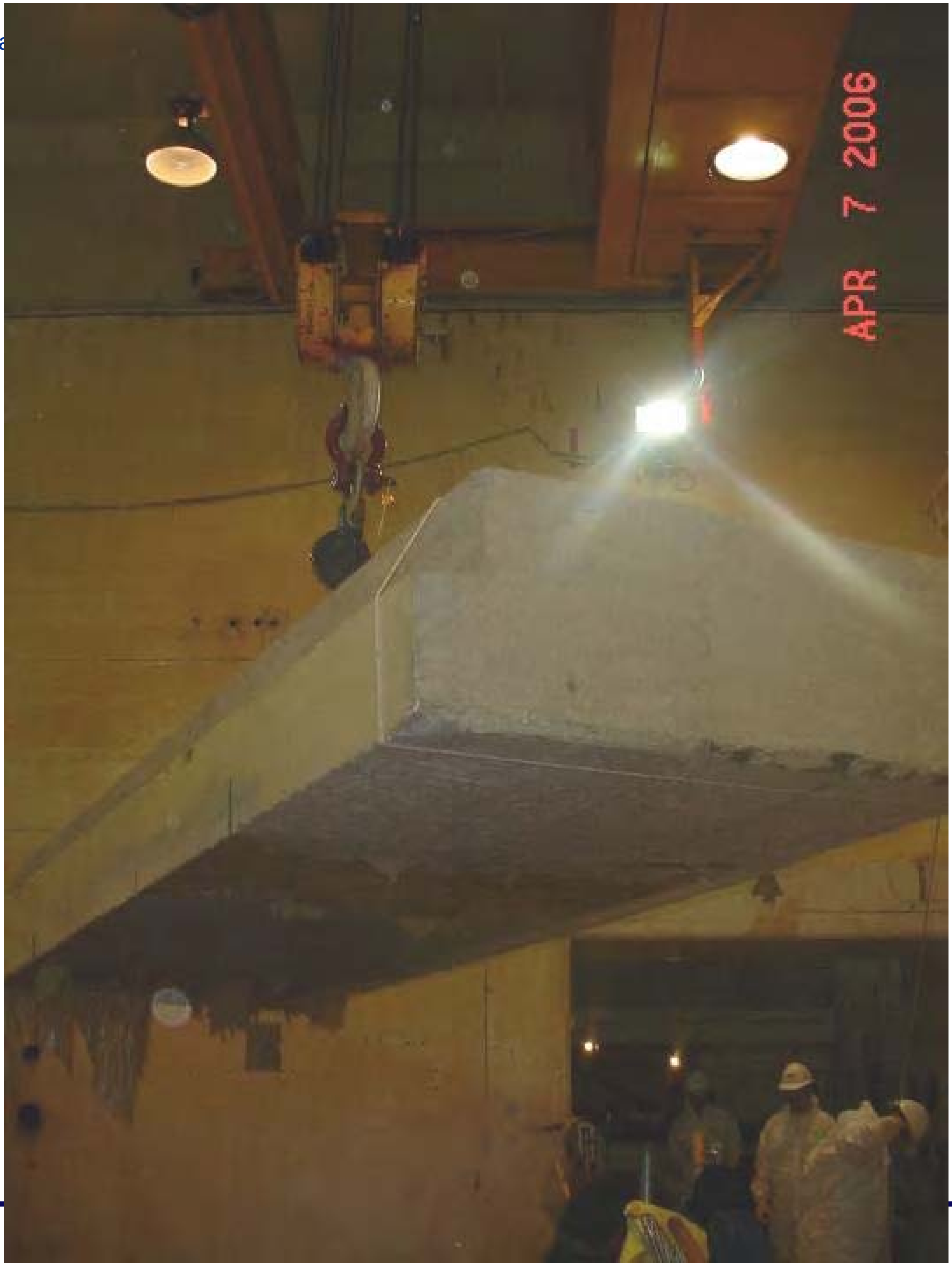
After


JAN 20 2006

JAN 20 2006

APR 7 2006

JAN 20 2006


APR 7 2006


P&H
15 TON
CAPACITY


ENTER BY
PERMIT ONLY

Fan House Basement - Before




Hot Pipe Tunnel - Before

Hot Pipe Tunnel Roof and wall - after

Brokk with Depth Guide

HPT Floor with 1” of concrete removed

Sponge Jet Blaster

Unistrut – Before and After

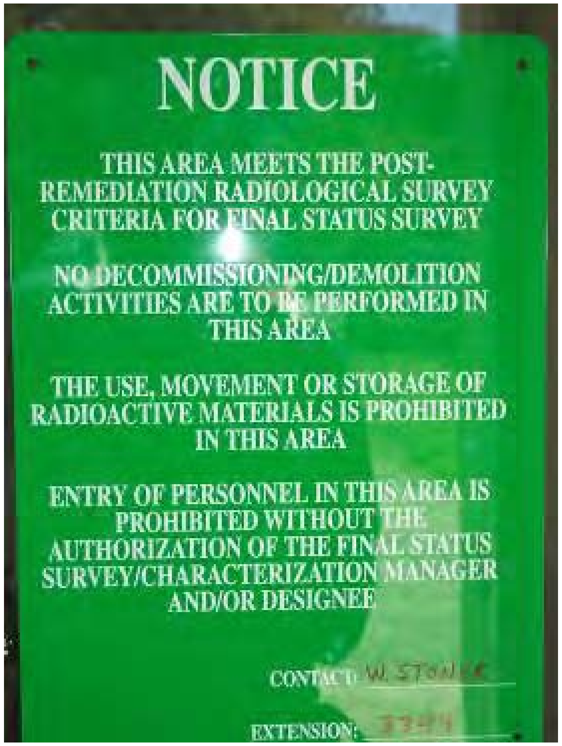

DANGER
PERMIT REQUIRED
CONFINED SPACE

Warm Handling Room - before




Where we are today
Final Status Survey

- Final Status Survey (FSS) is the final step in decommissioning leading to license termination
- FSS is how we prove we have cleaned all remaining surfaces, structures, and open land areas to the level that is safe
- Nuclear Regulatory Commission approved our FSS Plan in March 08
- FSS field work began in the Reactor Office Laboratory Building in September 07




165
SR-31
BCR-5
9-28-06

Off Site Contamination

- In October of 2005 Cesium-137 was discovered in the sediment of Plum Brook, an offsite stream that was part of the normal discharge path for ‘clean’ process water during the operating days.
- The levels were low enough that environmental monitoring performed over the years did not detect them, but once FSS sensitivity level instruments were used it was detectable.
- Background in the area for Cs-137 is about 0.5 picocuries per gram, levels we found averaged 2 to 3 picocuries per gram, though a few elevated readings in the 20 – 30 picocurie per gram range were seen.
- An immediate scoping investigation was launched to determine the scope and extent of the Cesium issue.

Off-Site Contamination (cont)

- The scoping survey confirmed the presence of low levels of Cs-137 down the length of Plum Brook
- NASA immediately notified the federal, state, and local officials, the media, and the public
- A commitment was made to thoroughly investigate the issue, and to do what was necessary to insure the safety of the public.
- The entire effort took just over 2 years. Throughout it NASA has kept all parties involved, including letters to the affected property owners with sampling results, public updates at the Community Work Group meetings, and periodic interviews with local media.

Where we are today
Plum Brook

- NASA has finished its sampling efforts along Plum Brook and in Sandusky Bay
  - Characterization – determines what is there, and what level
  - Bounding – determines the physical extent of the deposit

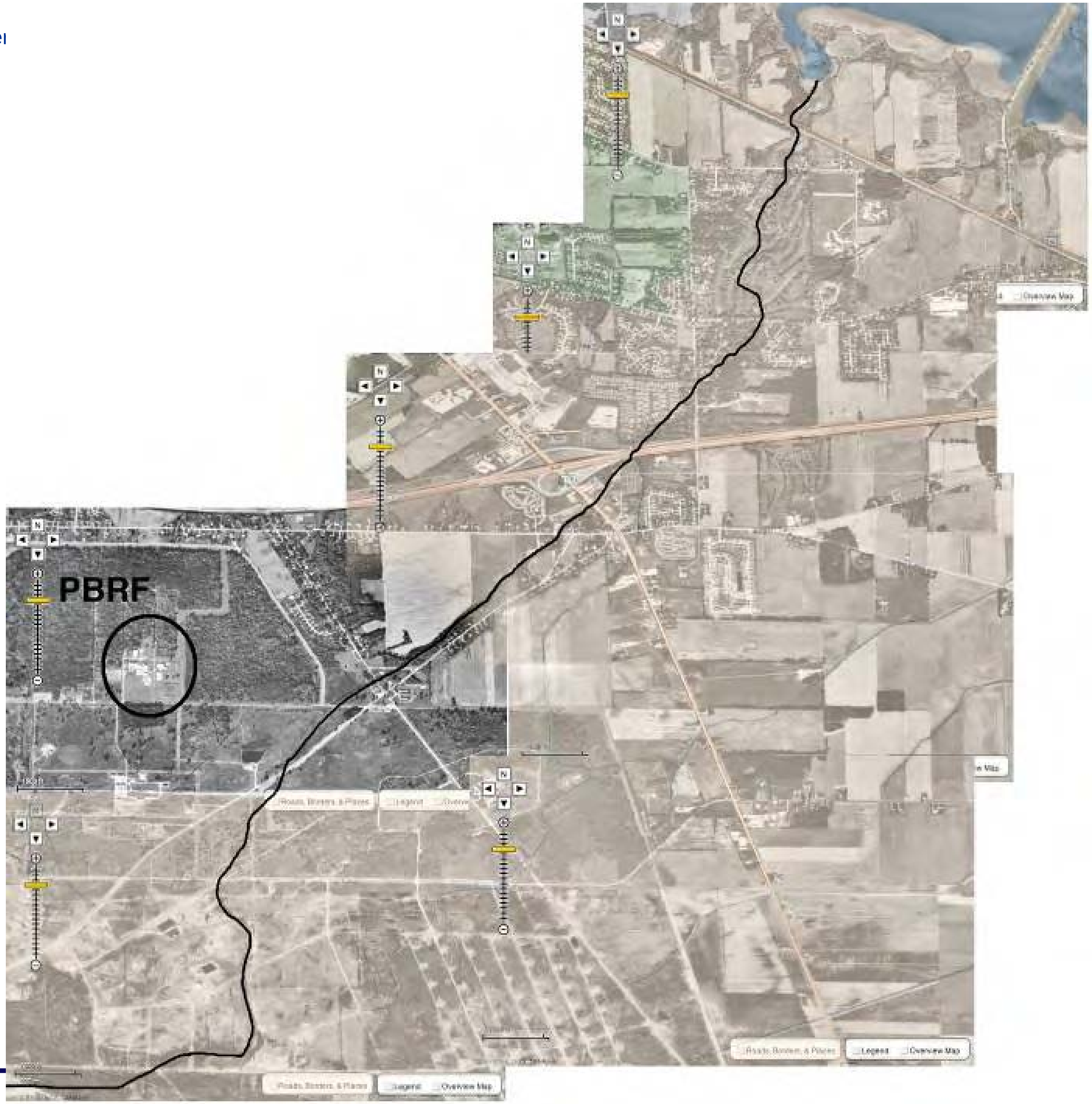
- Based on a detailed analysis of the stream hydrology, and collecting and analyzing over 5,000 sediment samples NASA can with confidence say
  - **There is no health concern for those who live, work, or play along Plum Brook**
  - **There is no health concern for the city of Sandusky using Sandusky Bay as a source of drinking water**

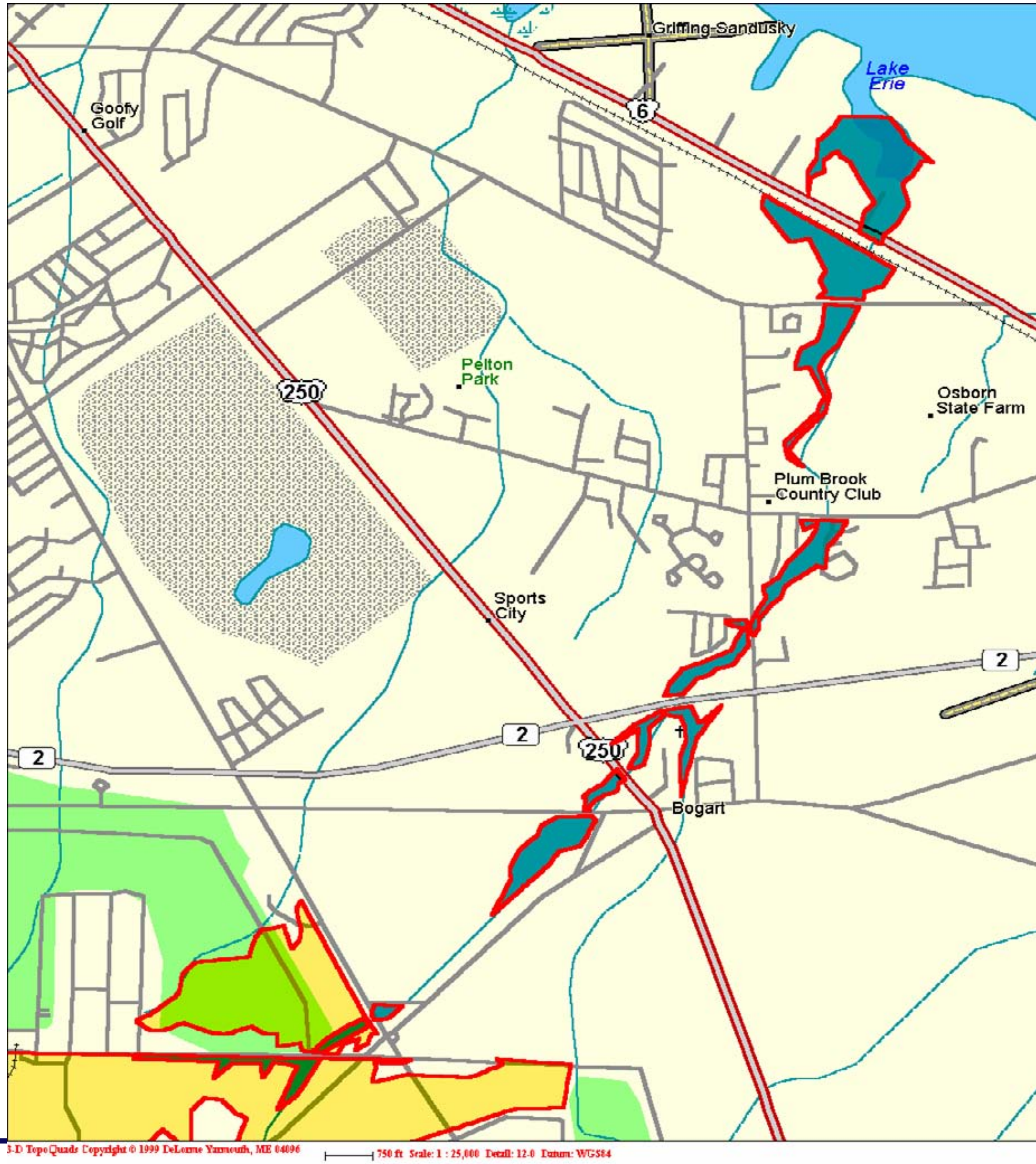
Plum Brook (cont)

- With guidance from Haag Environmental Company, a local company with hydrogeologic expertise, we understand what happened to the cesium-137 that was discharged from the facility during operation
  - How the material moved downstream over time
  - Where it is now
- Cesium binds almost permanently with clay sediment
  - Find where the sediment moved to, you find the cesium
- Deposits, or cells, tend to be isolated, relatively small in physical size, and are often buried under several inches to several feet of clean sediment, with only the edge next to the stream exposed.

Plum Brook (cont)

- We now have a much better understanding of where the material is and how much, the hydrology, and current and projected land use for the various sections of Plum Brook
- Based on this knowledge, and at the NRC's suggestion, NASA is performing an analysis to establish the isotope specific clean up levels or Derived Concentration Guide Lines (DCGLs) that will be specific for Plum Brook and reflect actual conditions.
- NASA is committed to clean up Plum Brook using the same standard that we are applying to the reactor site. The Plum Brook specific DCGLs will ensure this is the case.

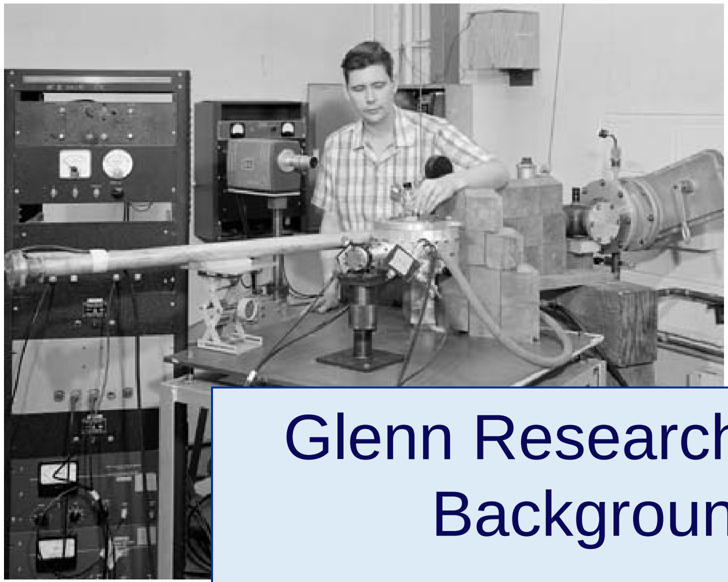

PBRF

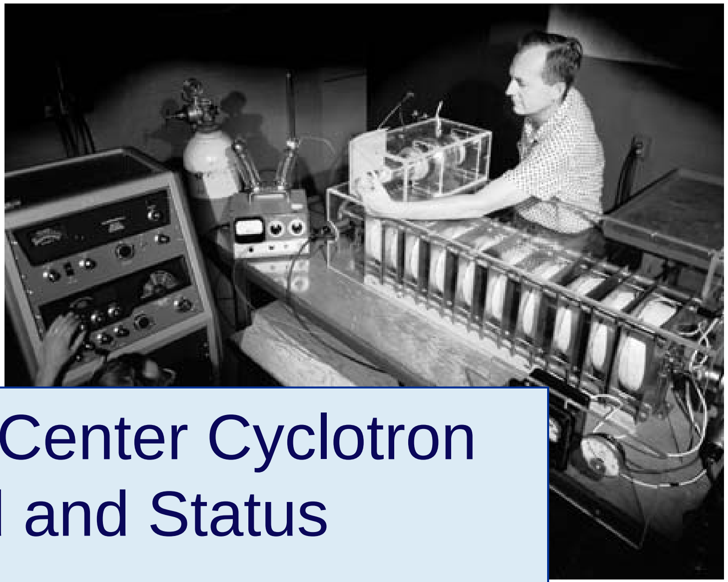

Griffing-Sandusky
Lake Erie
6
Goofy Golf
Pelton Park
250
Osborn State Farm
Plum Brook Country Club
Sports City
2
250
Bogart
3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096
750 ft Scale: 1 : 25,000 Detail: 12-0 Datum: WGS84

Plum Brook Characterization and Modeling

What's next?

- Complete decontamination and remediation of remaining structures, Pentolite Ditch and Plum Brook.
- Prepare surfaces for Final Status Survey
- Complete Final Status Survey
- Terminate licenses.
- Site Restoration





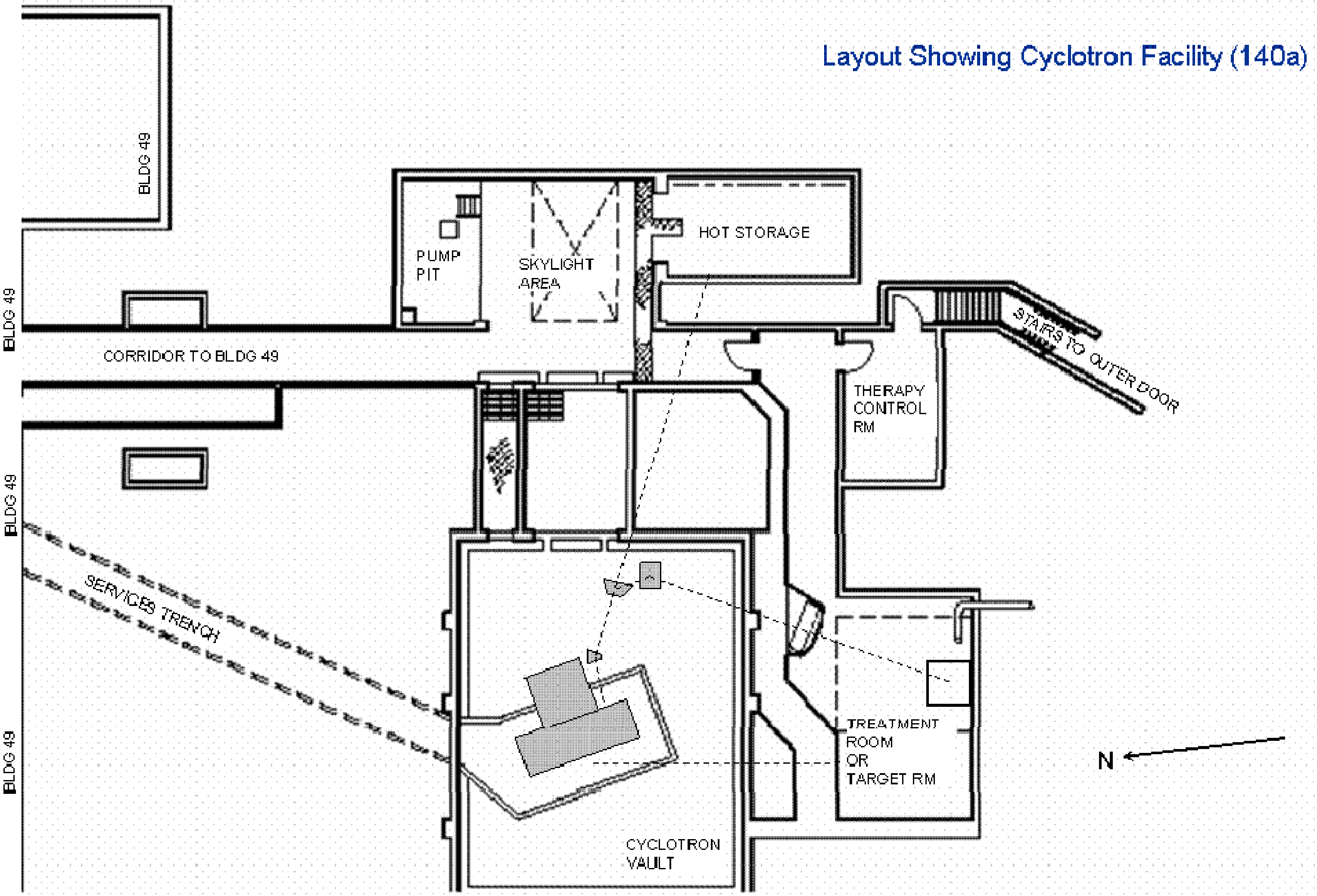
Glenn Research Center Cyclotron Background and Status

Chris Blasio, GRC RSO

Cyclotron Background

- The Glenn Research Center's Cyclotron is located in the southern portion of the GRC Lewis Field campus.
- Construction completed in 1955
- Operated until 1980 by NASA, used to expose various materials to energized streams of subatomic particles to determine the effects of radiation exposure.
- Operated under a Space Act Agreement with the Cleveland Clinic from 1980 to 1990 for medical research.
- Facility has been in a shutdown mode since 1990.

Cyclotron Background



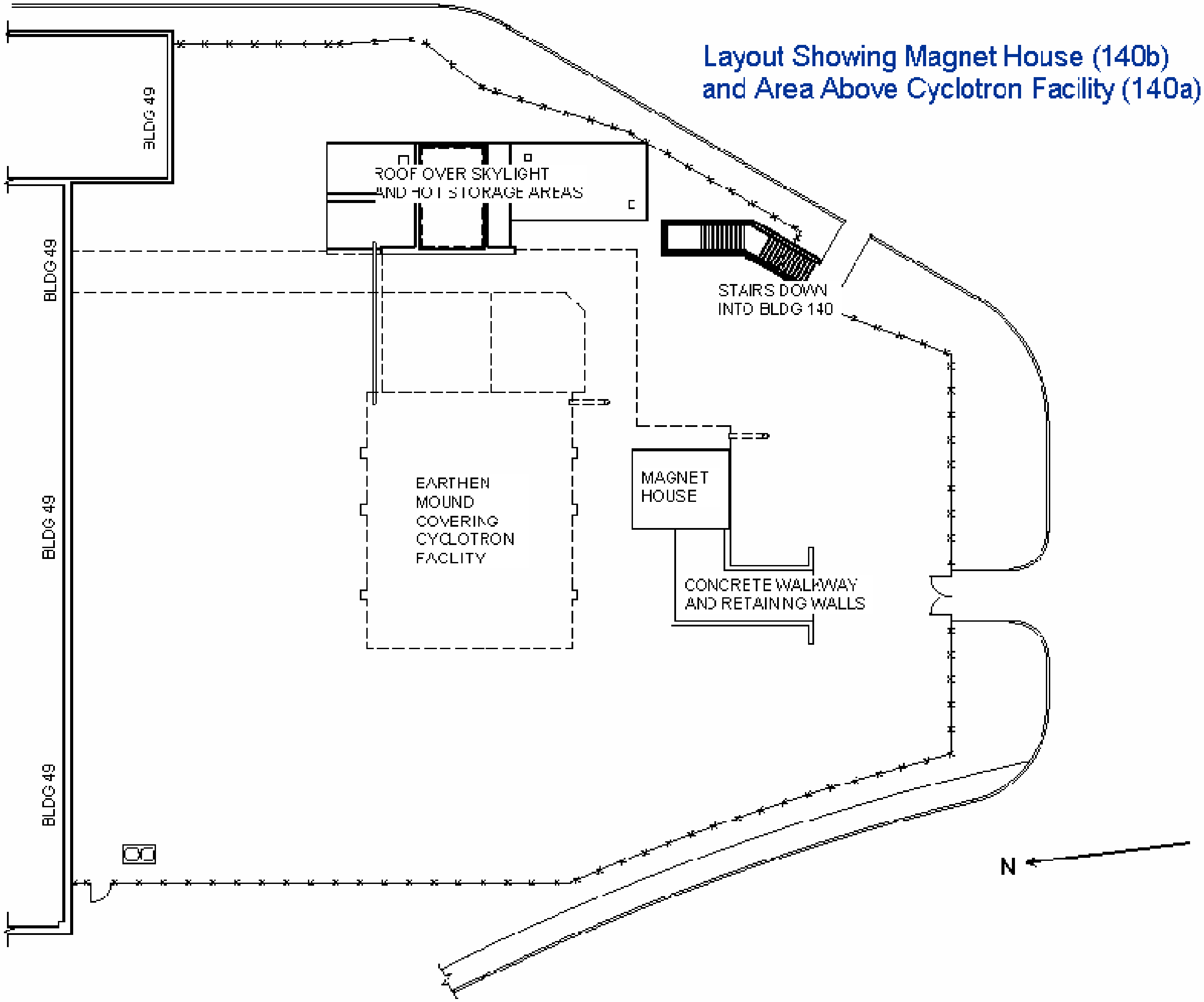
Cyclotron Background

View of Machine From NE Corner as Enter Cyclotron Vault

View of Machine From W-side of Cyclotron Vault

View of Beam Path from Atop Machine

Cyclotron Background



NRC Involvement

- GRC has an NRC 'Byproduct Material' license which allows for the possession and use of various radioactive materials and sources in support of research and development.
- The NRC's oversight role of radioactive materials increased with the "Energy Policy Act of 2005" which was intended to gain greater control of byproduct material.
  – Effective 11/07, the Act changed the definition of 'byproduct material' to include all material activated by the cyclotron, whether intentionally or not.
- As a result, GRC has notified the NRC of the cyclotron's presence and is moving forward with amending its radioactive materials license and will be providing the NRC with a plan for decommissioning the site.

Decommissioning

- The overall goal is to clean the site to a level that allows the termination of the NRC license and the unrestricted future use of the formerly licensed site.
- Decommissioning a nuclear facility is performed in several steps:
  – Step 1 – Characterization
  – Step 2 – Decontamination
  – Step 3 – Final Status Survey

Decommissioning – Step #1

- Characterization – A well thought out physical sampling campaign, based on a Historical Site Assessment, interviewing past operators, review of operating logs and procedures, and any other information that will help uncover the locations of potentially contaminated or activated material.
  - The first step in this effort is to draft a written plan that lays out the sequence of actions to be taken.
  - Ultimate activity is the actual sampling effort in the cyclotron area to determine exactly what radioactive isotopes are present, where they are, and at what concentrations.
  - Sampling includes direct instrument readings, core bores, and analysis of samples of various surfaces throughout the facility.

Decommissioning – Step #2

- Decommissioning Plan – With the knowledge gained from the characterization, specifically the nature and extent of the material that must be removed, a plan can be developed to do the necessary clean up.
  - Key decisions to be laid out in the plan include the overall approach (decontaminate vs. rip and ship), decommissioning technologies to be used, the identification and volume estimates of various waste streams (Class A,B,C Low Level Rad Waste, Mixed Waste, asbestos, lead, others), and the ultimate disposition pathway for each waste stream.
  - All of this information is necessary to put together a meaningful cost estimate.
  - Decommissioning Plan is reviewed and approved by the NRC.

Decommissioning – Step #3

- Final Status Survey Plan – This document will develop the required clean up levels, in accordance with a standard, regulatorily accepted protocol (MARSSIM) and dose analysis computer code (RESRAD). It will also detail how the achievement of the clean up levels will be demonstrated and documented.
  - Clean up levels developed concurrently with the Decommissioning Plan
  - MARSSIM has several scenarios – most appropriate for the cyclotron would be the "Building Reuse Scenario" - it will result in clean up goals that are less stringent than the "Resident Farmer Scenario"
  - FSS conducted as the final step after clean up
  - Following successful FSS and license termination the former location of the cyclotron may be released for any desired reuse.
  - FSS Plan is reviewed and approved by the NRC.

Nominal Schedule

- The NRC wants to see progress on the decommissioning of the cyclotron, but is reasonable in its expectations. A plan that extends over several years will be acceptable, as long as there continues to be progress.
- A possible schedule might be as follows:
  - FY 2009 – Develop Characterization Plan
  - FY 2010 - Conduct Characterization
  - FY 2011 – Prepare Decommissioning Plan and FSS Plan
  - FY 2012 – 2013 – Conduct Decommissioning and FSS

Leveraging off the PBRF Decommissioning

- NASA GRC is currently decommissioning the NRC licensed Plum Brook Reactor Facility (PBRF). There are several ways the cyclotron project could leverage off of the reactor project:
  - Knowledgeable personnel at PBRF, both Civil Servant and Contractor, who can support the cyclotron project's start part time and eventually shift over to full time to staff as the reactor project winds down and the cyclotron ramps up.
  - The PBRF and cyclotron decommissioning efforts would have the same NRC inspectors, so there are good working relationships already in place.
  - Existing radiological analytical lab on-site at Plum Brook can perform analysis of characterization samples from the cyclotron saving significant off site lab costs.
  - Existing written procedures, in such areas as radiological control, waste management and disposal, and FSS can be easily adapted for use at the cyclotron (hit the ground running)

Medical X-Ray Compliance

J. Bai

Bureau of Radiation Control
State of Florida

5/15/2008

Medical Diagnostic Radiography Discussion For Health Physicists

Bureau of Radiation Control

Division of Environmental Health

- Jerry Bai
- Environmental Manager
- Florida Bureau of Radiation Control

- Regulate and Inspect x-ray machines

Resources

- Local regulations (www.myflorida.com)
- FDA
- CRCPD
- AAPM
- Manufacturer sites
- Local Medical physicists
- Consultants
- Regulators
- Text books (Bushong)
- NCRP

Types of x-ray machines

- Medical
- Industrial

Types of Medical X-ray Machines

- Therapy
- Fluroro
- Radiography
- Dental
- Specials
- Other

Types of Medical Radiography Machines

- Fixed
- Mobile
- Portable

Objectives

- Maximize Diagnostic Value
- Minimize Exposure

X-ray Systems

- X-ray Machine
  - Console
  - Generator
  - Tube
- Imaging System
  - Film / Processor
  - CR Screens
  - Full Field Digital
- Exam Room
  - Table
  - Upright
  - Barriers and Shielding
- Techniques
  - Manual
  - Automatic Exposure Control (AEC)

X-ray Techniques (settings)

- kVp
- mA
- Time (sec)

- kVp
- mAs (mA x Time)

Typical X-ray Techniques

- Hand
  - 50kVp, 1mAs, 5mR
- Chest
  - 109kVp, 5mAs, 10mR
- Abdomen
  - 75kVp, 30mAs, 280mR
- Lumbar
  - 78kVp, 35mAs, 320mR

Quality Assurance

- Policy & Procedures
- Evaluation of Setup
- Reviews
- Tests

Policy and Procedures

- Are good policy and procedures in place and available to staff?
  - Patient holding
  - Technique charts specific to equipment
  - QC procedures
  - Maintenance
    - What is serviced and at what frequency?

Evaluate Setup

- Barrier placement – Primary vs Secondary
- Console placement vs Patient and Tube placement
- Equipment matchup – Film to screen, Film to processor
- Lead Gloves, Aprons
- Entrance Warnings, Locks
- Comfort – Table cushion, chair, step stool, bathroom, adjustible lighting

Evaluate Setup (cont)

- Darkroom – Light leaks, Fluorescent bulbs, Darkroom Filters, Positive Locks, Warning Signs
- X-ray centering to image receptors
- Tube stability
- Interlocks
- Reading Room – Quiet, Lighting, Viewer, Chair.

Record Reviews

- Periodic review of procedures
- Personnel monitoring reports
- Maintenance / Service logs
- Quality Control logs

Tests

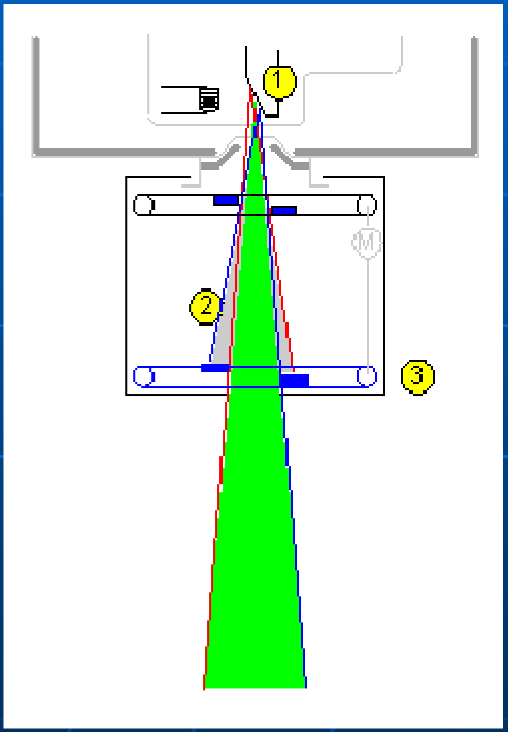
- Need appropriate equipment.
  - X-ray meters (exposure reproducibility, Timer and kVp accuracy, Linearity, HVL)
    - ~50-120 kVp range
    - 0.008 sec
  - Need special scatter probes to accurately measure scatter x-rays.
  - Markers, Testing film (Beam accuracy)
  - Copper or Acrylic (AEC)

Primary Barrier

- 1/16” (~2mm) Pb equivalent (Florida)
  - 1/32” or 8’ for secondary
- Rule of thumb: 1/10th exposure at 80kVp with a radiation meter.
- Area monitors are excellent for MOP surveys.

Collimation Test

- Light field must match x-ray field within 2% of the SID (40”=0.8” and 72”=1.4”).
- Beam cannot exceed image receptor.
- Need film, markers, and a measuring tape.



HVL

- Need a meter with Auto HVL readout or
- ~3.5mm Al attenuation and a x-ray meter.
  - (mmAl)(ln(2))/ln(Exp1/Exp2)

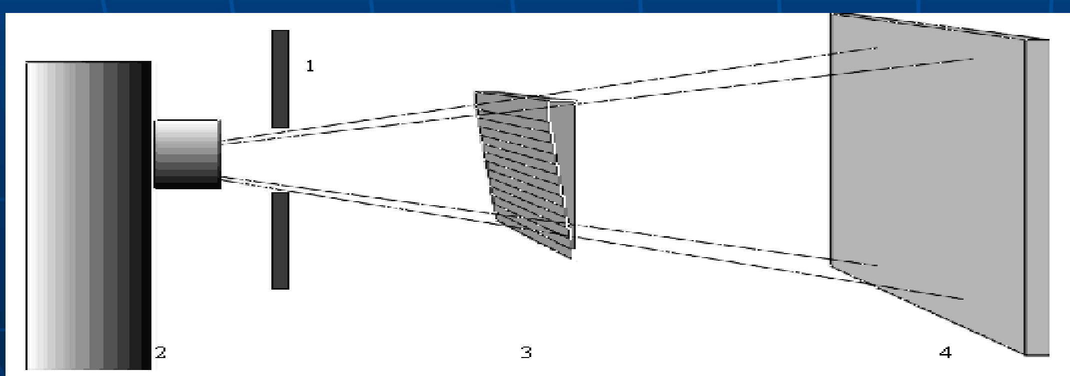


Figure 1: Scheme for the measurement of the SNR with the step wedge method

Exposure Reproducibility

- Need X-ray meter
- Emean ≥ 12 (Emax - Emin)

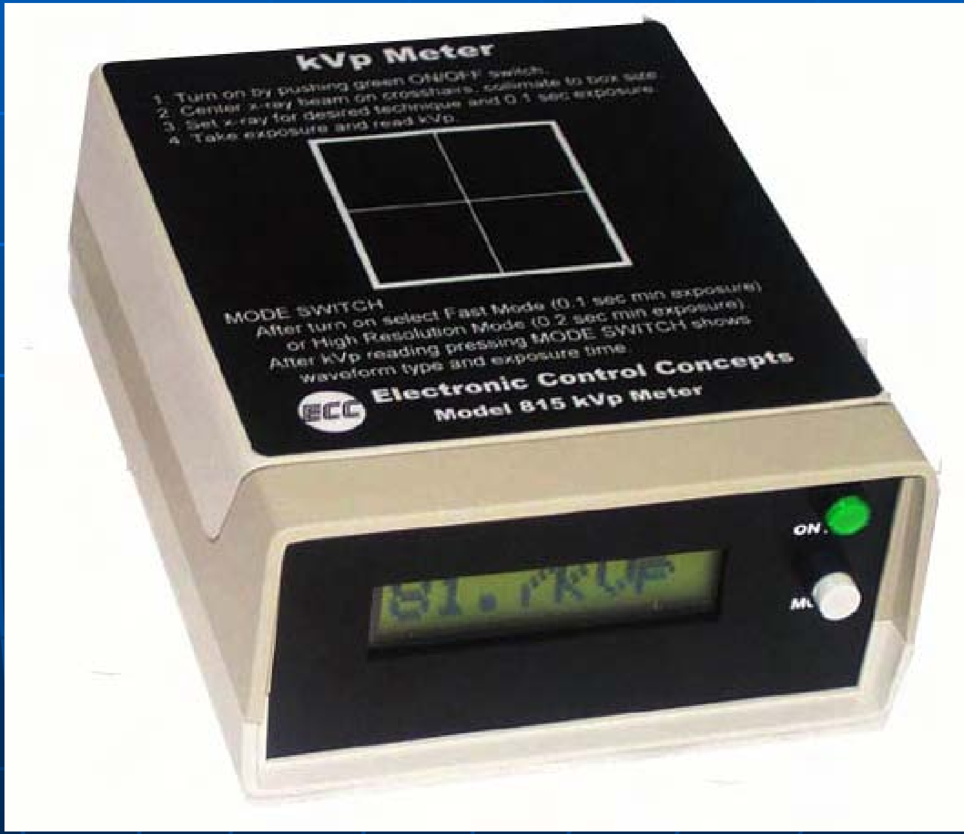
- 146mR, 148mR, 150mR, 148mR
    - 148 ≥ 48, True

Timer Accuracy

- Need X-ray meter
- Within 10%

kVp Accuracy

- Need X-ray meter
- Within 5%



Exposure Linearity

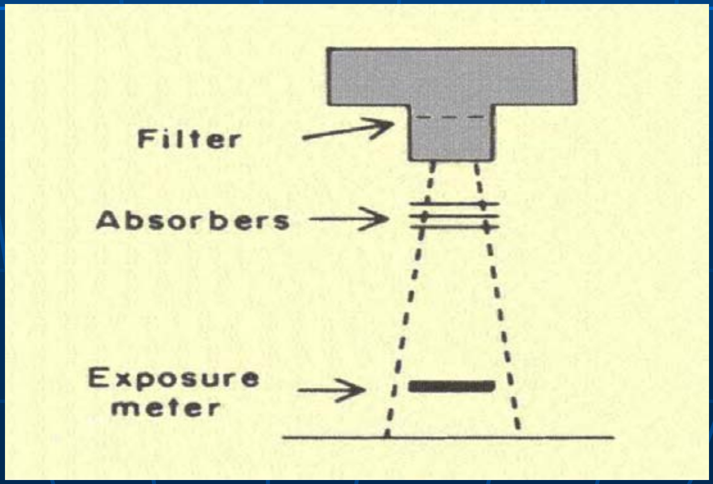
- Need X-ray meter

- Where X=output ratio, Exp/mAs
- $(Xa - Xb) \leq (0.05)(Xa + Xb)$ if adjacent
- $(Xa - Xb) \leq (0.10)(Xa + Xb)$ if not adjacent

AEC Reproducibility

- Need attenuators to simulate patient
- Need x-ray meter

- Emean ≥ 12 (Emax - Emin)



AEC Compensation

- Need multiple attenuators to simulate patient.
- Need x-ray meter

Darkroom Fog

- Need light sensor or
- sensitized film and cardboard

FAA Outdoor Laser Safety and Software Demonstration

S. Rohring

Federal Aviation Administration

5/15/2008

FAA Evaluation of Proposed Outdoor Laser Operations

Presented to: 2008 NASA Health Physics Conference

By: Steve Rohring, FAA Focal Point for Outdoor Laser Operations

Date: May 15, 2008

Introduction

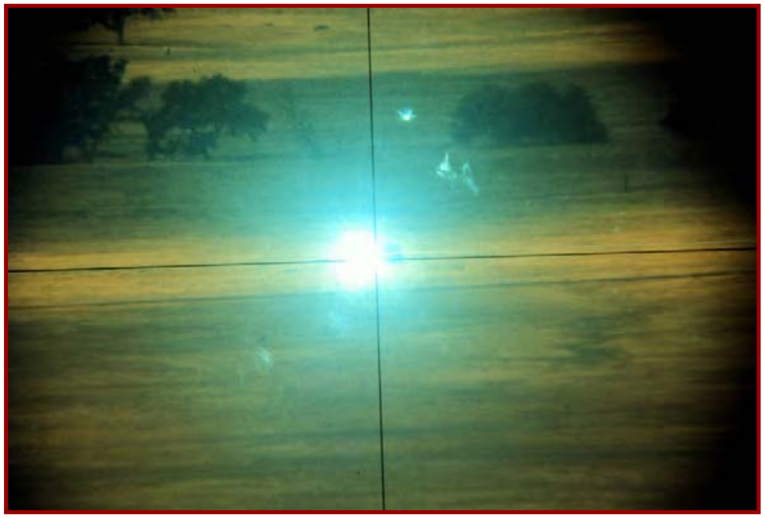
- Why does the FAA care about outdoor laser operations?
- How does the FAA evaluate laser proposals?
- How can the FAA's laser automation aid NASA?
- What tools/databases are available in the FAA's laser evaluation system.

Potential Adverse Visual Effects

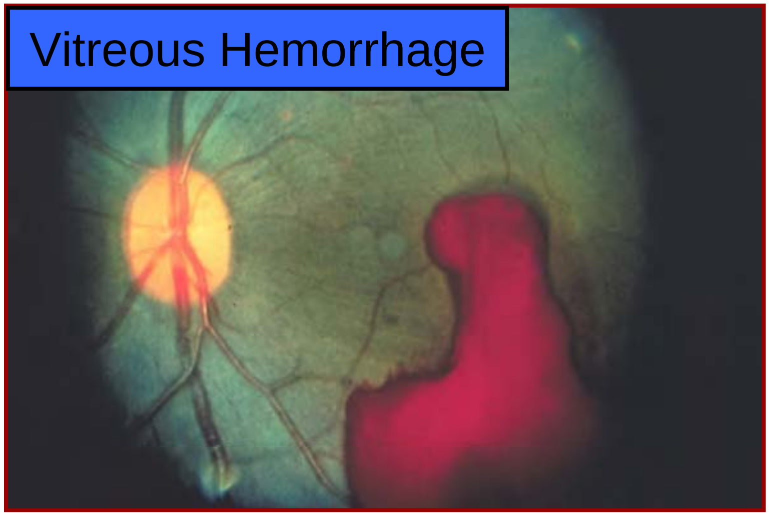
- Distraction
- Startle
- Glare
- Flashblindness
- Afterimage

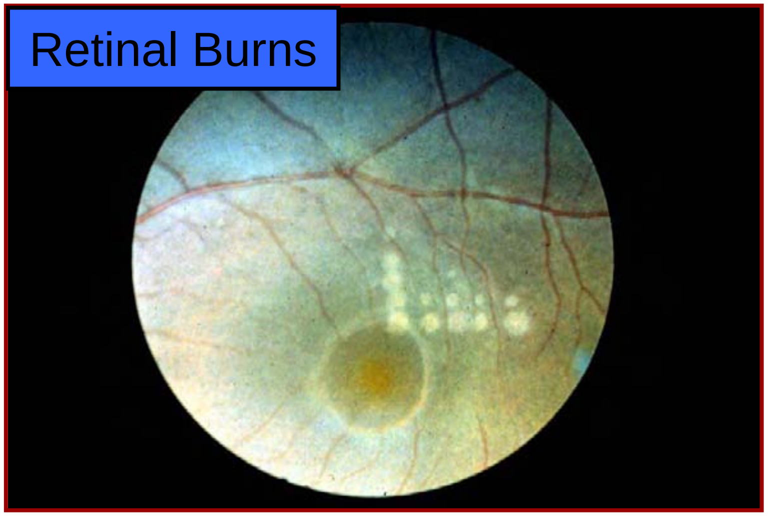
Greatest potential to cause an aircraft accident when an aircraft is flying at low altitudes and when pilots are performing critical tasks during landing and take-off.

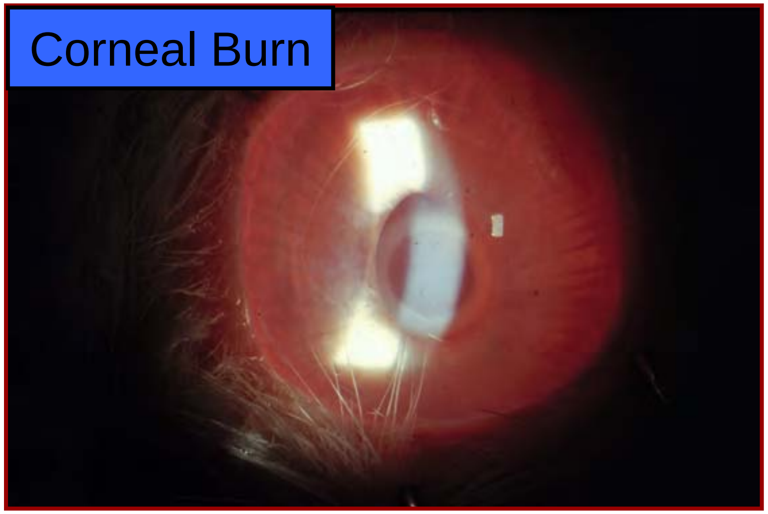
Example of Laser Glare



Potential Eye Damage







How to Notify the FAA

- FAA Form 7140-1, Notice of Proposed Outdoor Laser Operation(s).
  http://forms.faa.gov/forms/faa7140-1.pdf

- This is a 2-page form. The first page asks for general information. The second page is a Laser Configuration Worksheet that should be completed for each individual laser.

- FAA AC 70-1, Outdoor Laser Operations:
  http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/a79d573e9ff2aaaa86256f9d00583fe0/$FILE/AC70-1.pdf

Can NASA Notify the FAA Electronically?

- Not Yet, however, Pat Hancock, currently evaluating the system for use by NASA.

- The FAA prefers one NASA focal point for entering proposals into the System.

- Patrick’s contact information is:
- General Engineer
- Occupational Health Team Lead
- GSFC, Code 250
- 301 286-5605
- 301 286-1745 (fax)

When to Notify the FAA, cont.

- **Scientific/research lasers - <u>at least 6 months</u> in advance (include specific details on control measures that you intend to use ensure aviation safety)**

- **Evaluation is more complex than laser light shows**

- **May require a complex Safety Risk Management Assessment**

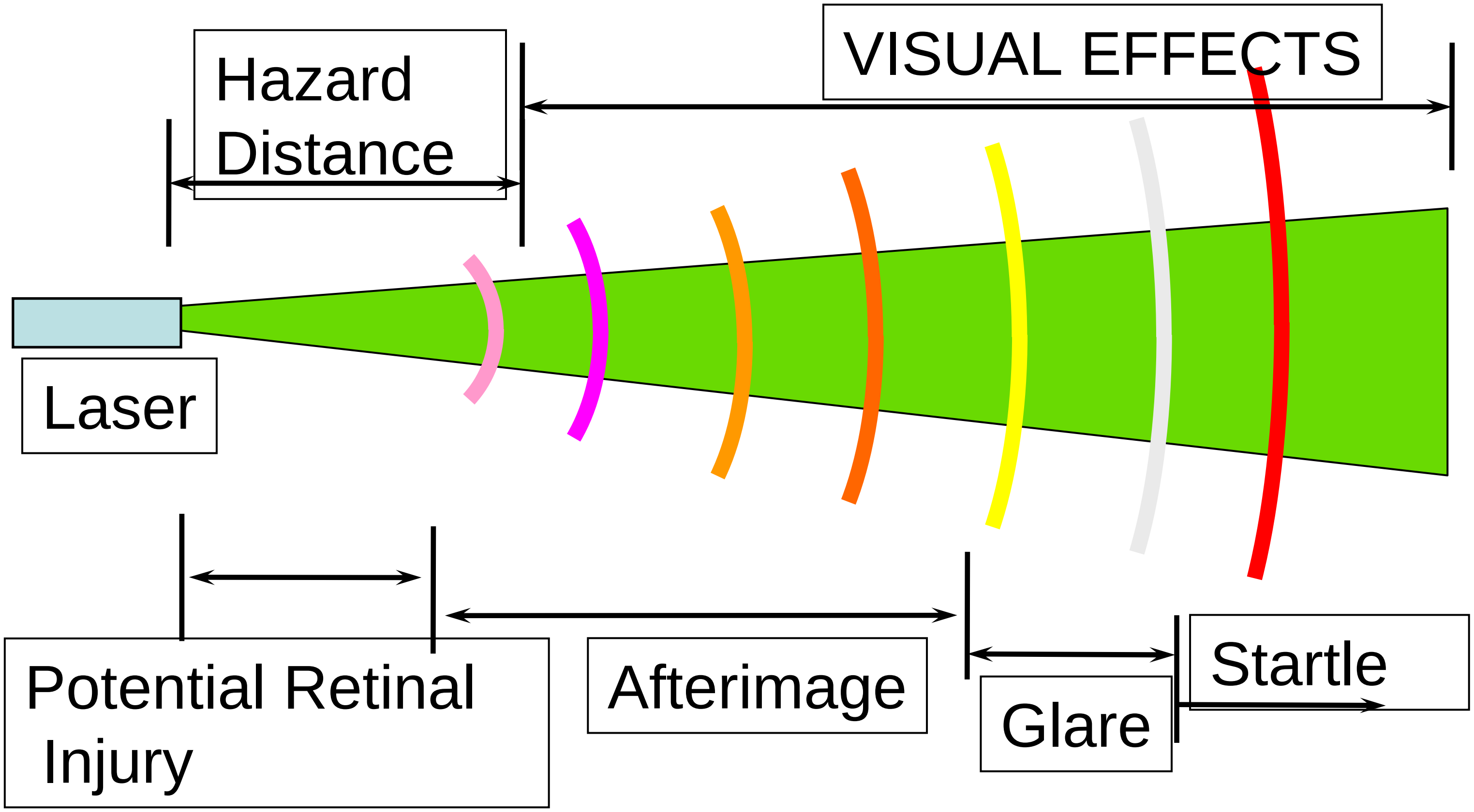
- **Typically takes 6 months or longer to complete.**

FAA Process

The FAA's Air Traffic Organization (ATO)

- Receives FAA Form 7140-1, Notice of Proposed Outdoor Laser Operation(s)
- Evaluates proposals in accordance FAA Order 7400.2, Procedures for Handling Airspace Matters
- The FAA's Regional Flight Standards Divisions conduct a Safety Analysis, and
- ATO Issues letters of objection or no objection.

Laser Hazards vs. Distance



From "Commercial Laser Pointers and Night Flying – Don't Be Startled," presentation, by D.H. Sliney, US Army Center for Health Promotion and Preventative Medicine, Laser/Optical Radiation Hazards Program (DOHS/25), Laser Eye Protection, p. 28.

Measurements, MPE & NOHD

Maximum Permissible Exposure (MPE)
The level of laser radiation to which a person may be exposed **without hazardous effect or adverse biological change in the eye or skin**. This value is used in the calculation of Nominal Ocular Hazard Distance (NOHD).

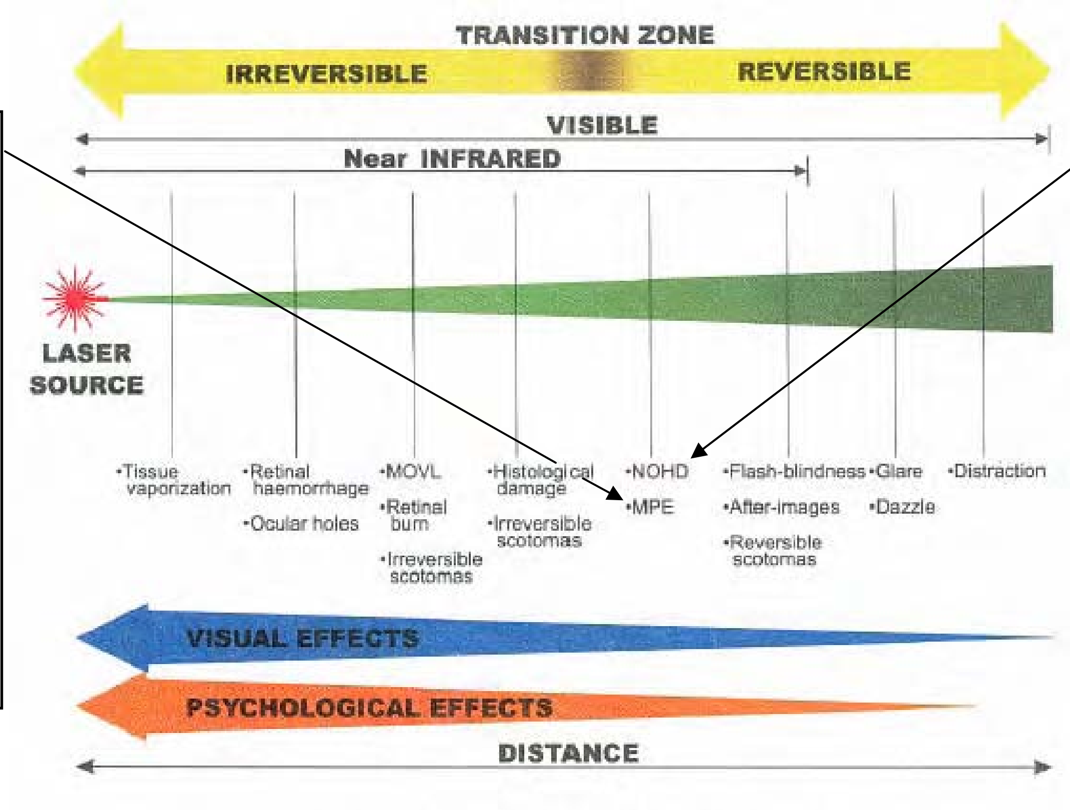


Figure 3-3. Ranges of laser beam bioeffects

Nominal Ocular Hazard Distance (NOHD)
The maximum distance from the laser system beyond which the laser beam irradiance **does not exceed the MPE for that laser**.

The beam is an eye hazard from the laser source to this distance.

Flight Zones/Distances

Flight Zones

Laser Free Zone (LFZ)

Critical Flight Zone (CFZ)

Sensitive Flight Zone (SFZ)

Normal Flight Zone (NFZ)

Calculated Laser Beam Distances

Laser Free Exposure Distance (LFED)

Critical Zone Exposure Distance (CZED)

Sensitive Zone Exposure Distance (SZED)

Nominal Ocular Hazard Distance (NOHD)

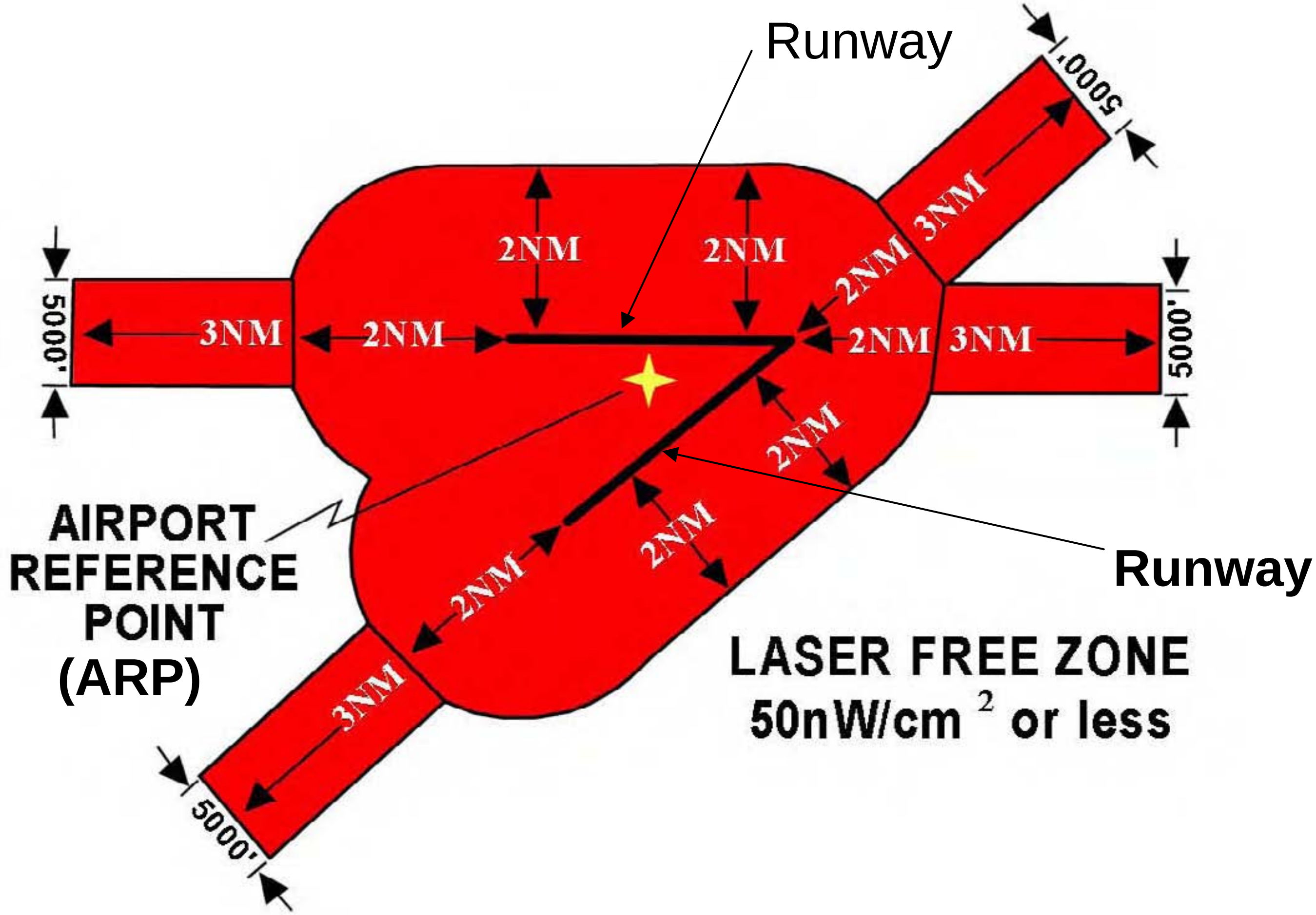
Calculated Laser Beam Distances

There are four laser beam distances that are important in evaluating the safety of ground-based outdoor laser operations.

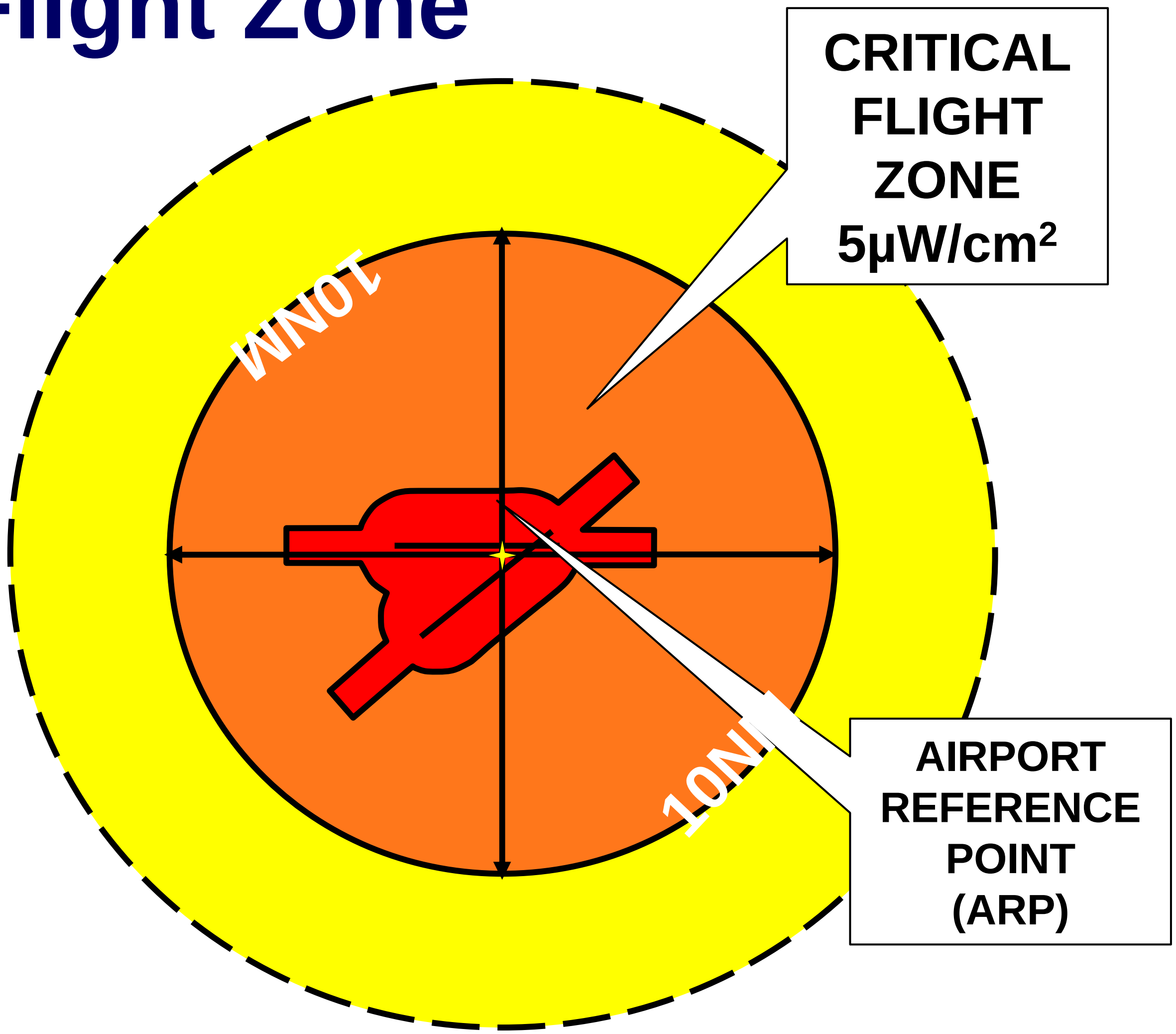
1. **Nominal Ocular Hazard Distance (NOHD) - The beam is an eye hazard (is above the MPE), from the laser source to this distance.**
2. **Sensitive Zone Exposure Distance (SZED) - The beam is bright enough to cause temporary vision impairment, from the source to this distance. Beyond this distance, the beam is 100μW/cm^2 or less.**
3. **Critical Zone Exposure Distance (CZED) - The beam is bright enough to cause a distraction interfering with critical task performance, from the source to this distance. Beyond this distance, the beam is 5 μW/cm^2 or less.**
4. **"Laser-Free" Exposure Distance (LFED) - The beam is dim enough that it is not expected to cause a distraction. Beyond this distance, the beam is 50nW/cm^2.**

The laser beam distances are calculated by the laser proponent and reported on the Configuration Worksheet, FAA Form 7140-1.

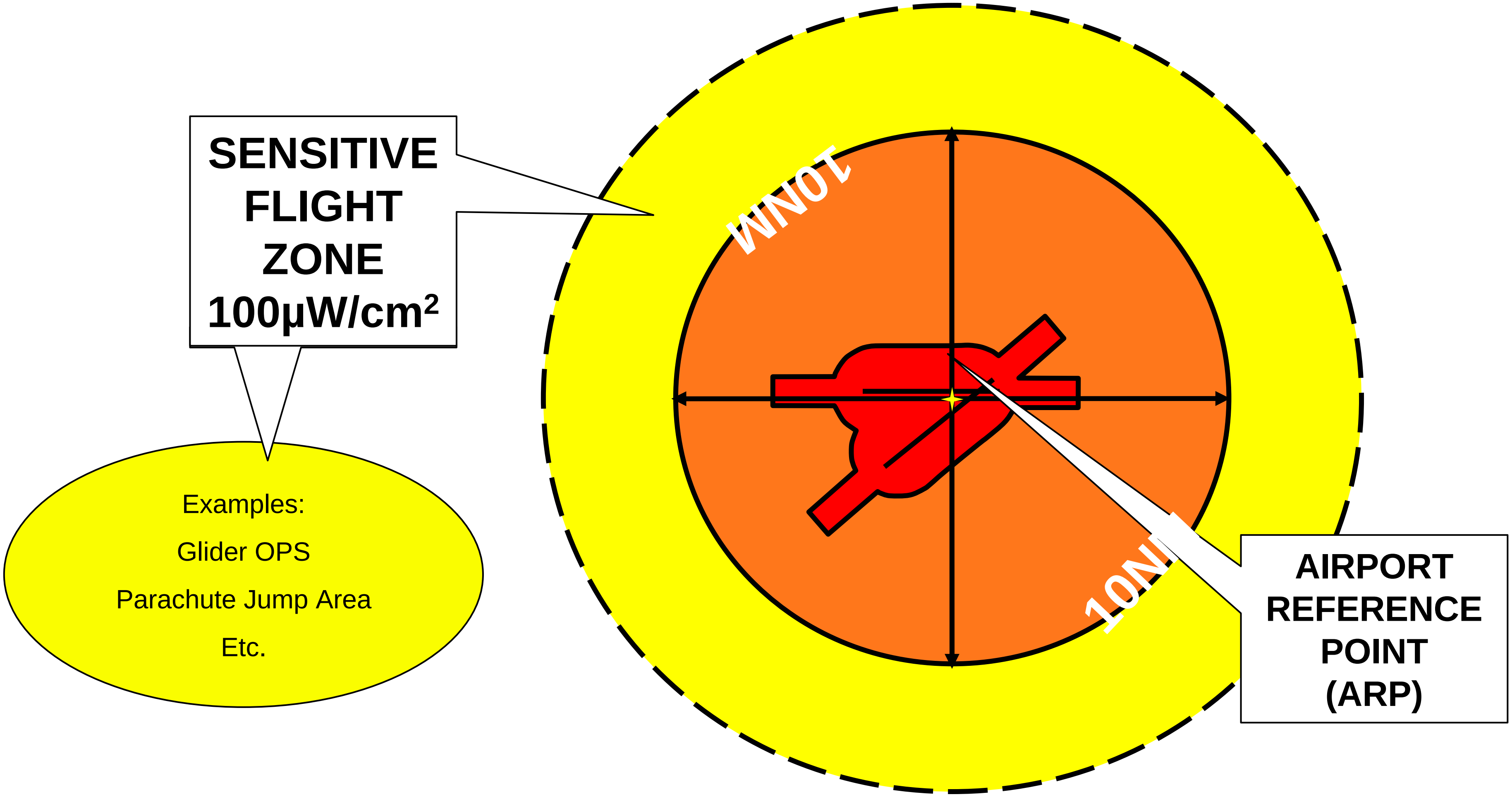
Airspace Flight Zones, cont.
Laser Free Zone



Airspace Flight Zones, cont.
Critical Flight Zone

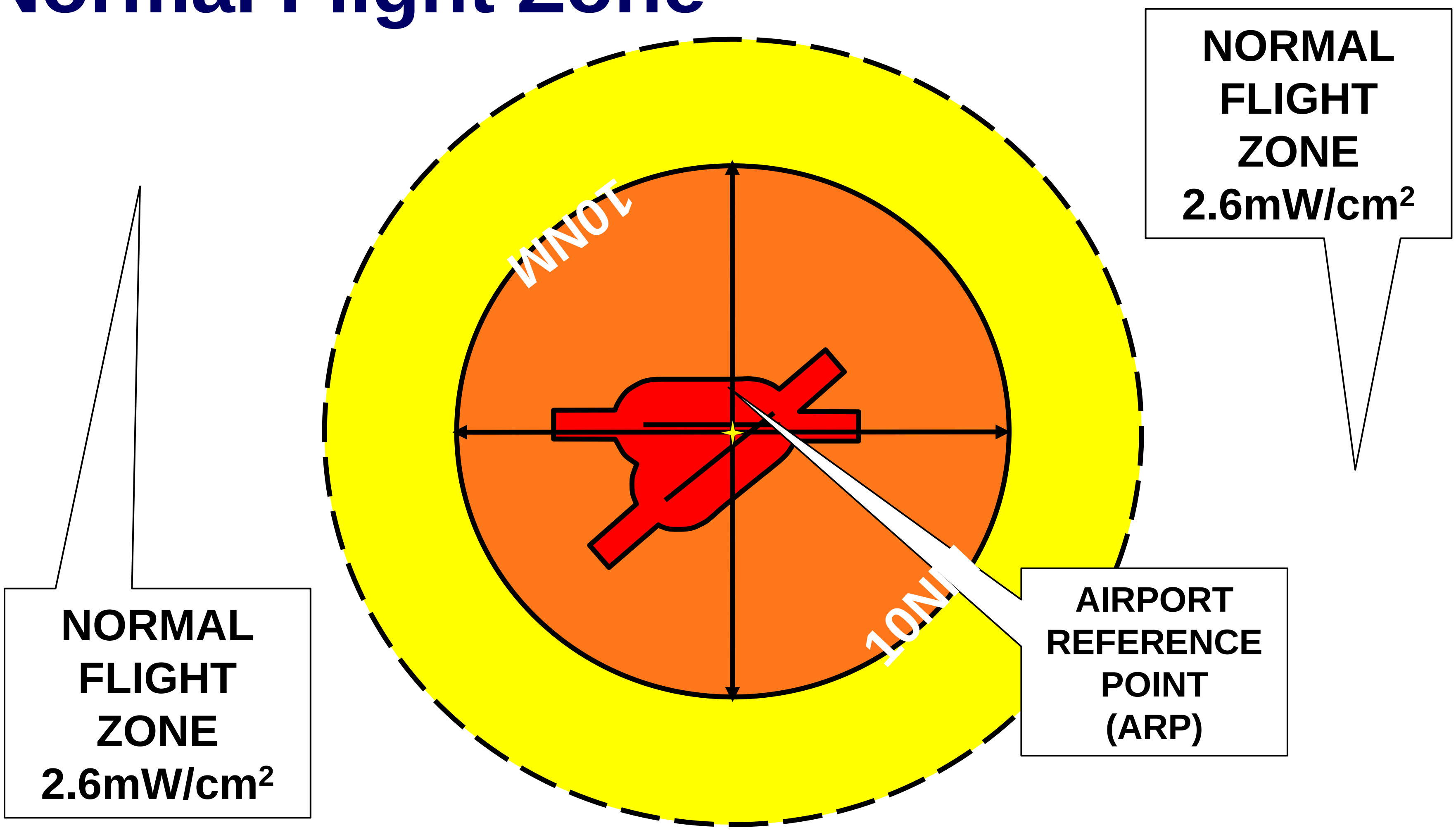


Airspace Flight Zones, cont.
Sensitive Flight Zone

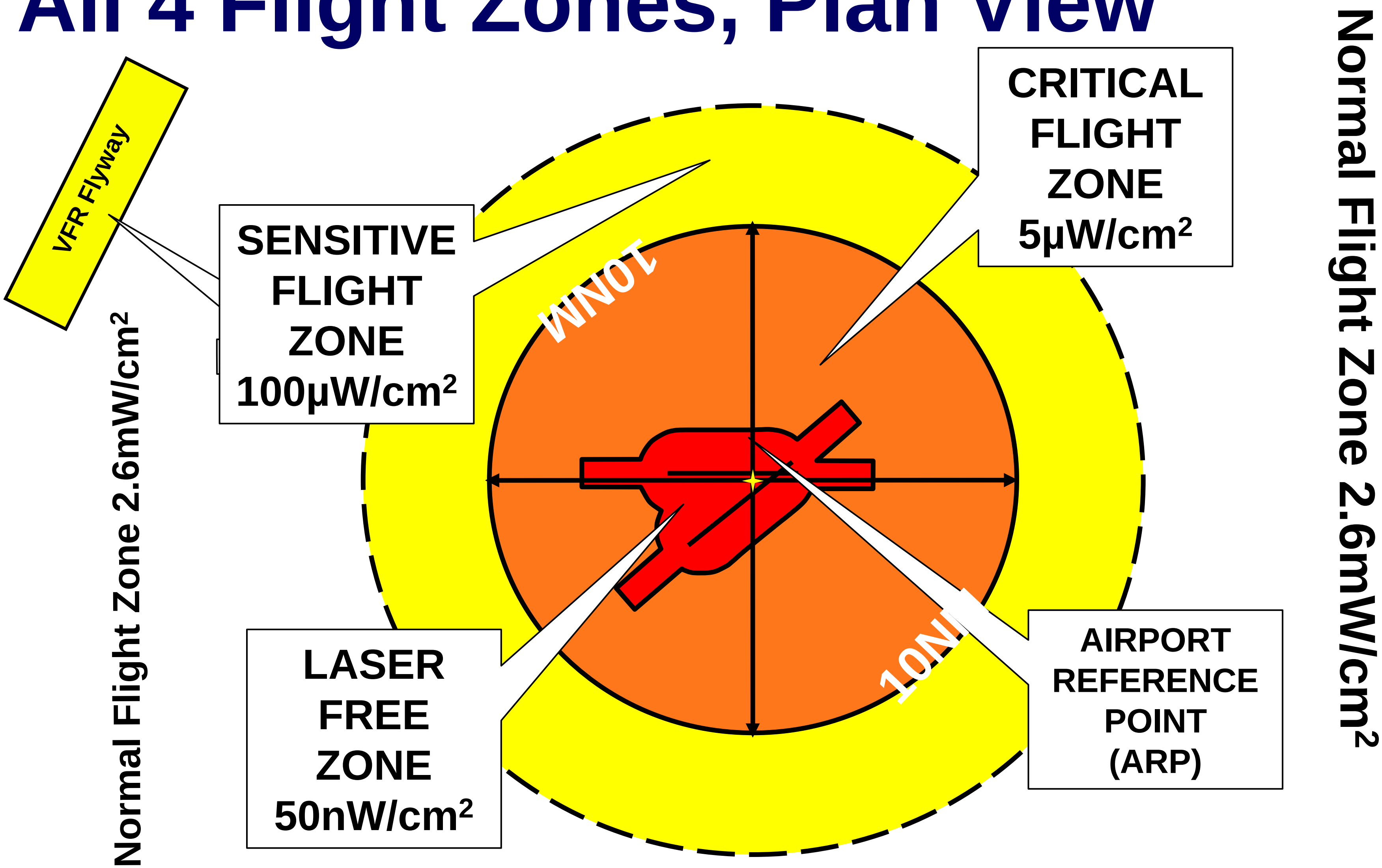


Airspace Flight Zones, cont.

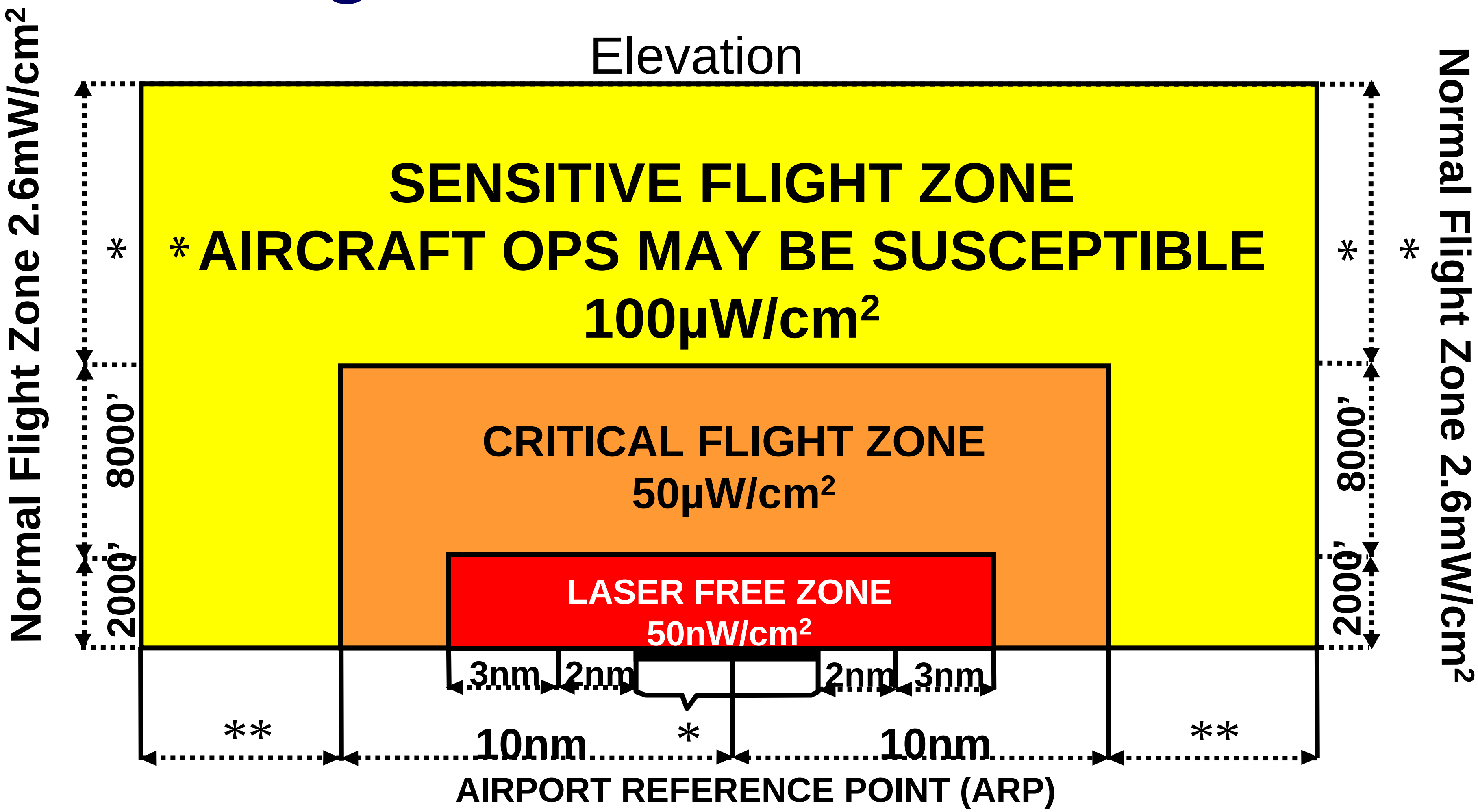
Normal Flight Zone



All 4 Flight Zones, Plan View

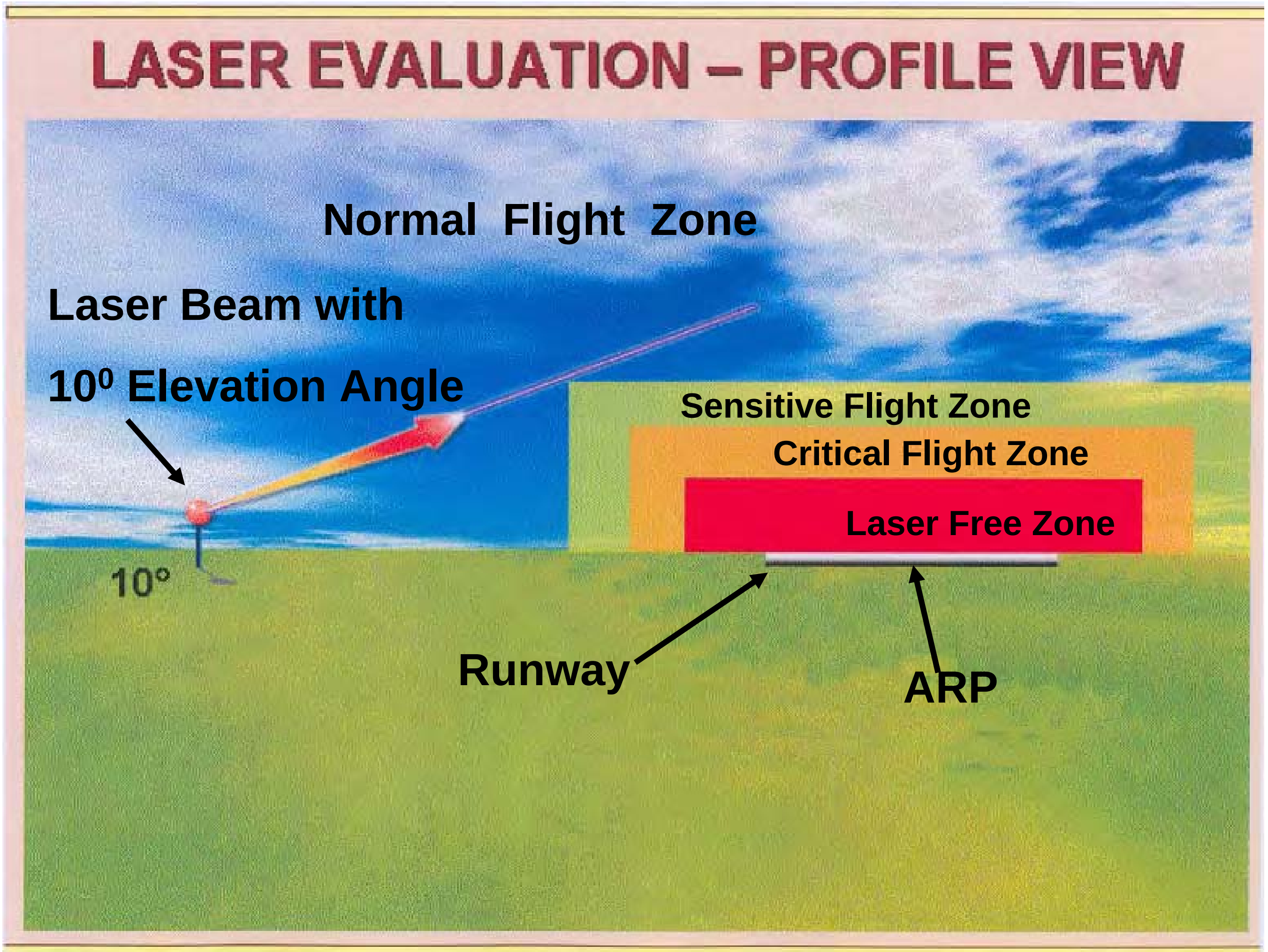


All 4 Flight Zones, Profile View



** Runway length varies per airport. AGL is based on published airport elevation.*
*** To be determined by local FAA evaluation and/or local airport operations.*

Flight Zone Evaluation



Demonstration of FAA Web-Based Laser Evaluation System

LaRC HP Program: Outdoor Laser Safety

K. Merritt

Langley Research Center

5/16/2008

Laser Safety Program at NASA LaRC

Kim Merritt, CLSO

Radiation/Laser Safety Officer

Mainthia Technologies, Inc.

Background

- LaRC is primarily an aeronautics and atmospheric science research center although we are involved in the ARES and CEV projects
- LaRC has over 75 active laser safety permits
  - Some permits cover only one laser some may cover as many as a dozen lasers
- We have approximately 375 registered laser workers although probably only half are actively involved in using or being around lasers.

Program basics

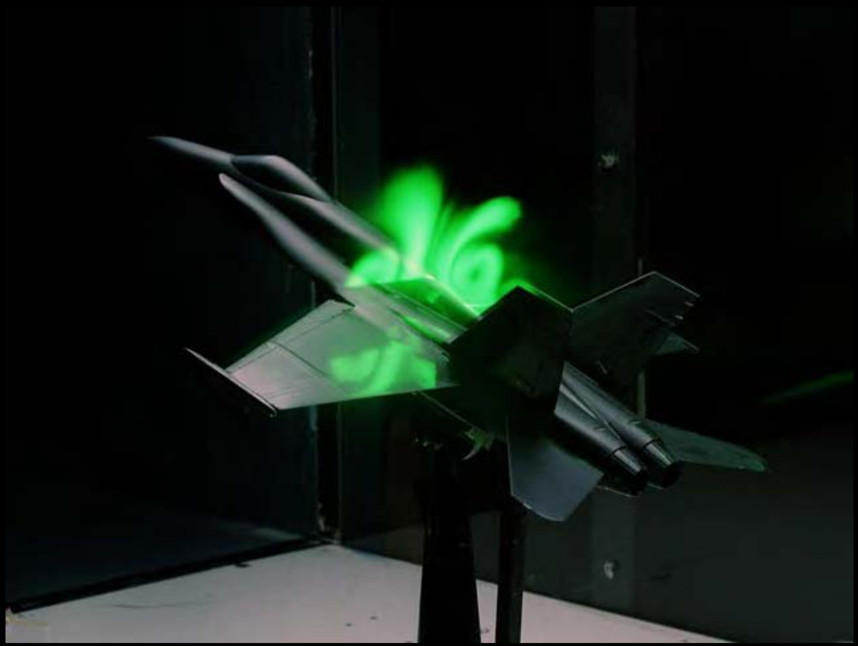
- All Class 4 and most Class 3b lasers get a safety permit
  - Safety procedures, facility layout, data table with MPEs and OD requirements for each laser
- Interlocks
  - These unfortunately are not fully standardized and most have been built in-house so they can be a bit quirky
- Audits
  - I visit each lab at least once a year, more often for most but only one visit is documented as an audit

Program basics

- Worker certification
  - All Class 3b and 4 users get formal safety training
    - Class room lecture and exam
  - Initial laser eye exams
  - I cannot certify contractors but I do give them the training
- Annual refresher training
- We are looking at putting the laser training online

Lasers in wind tunnels

- Flow visualization
- Particle Imaging Velocimetry
- Doppler Global Velocimetry
- Projection Moire' Interferometry
- Planar Laser-Induced Fluorescence

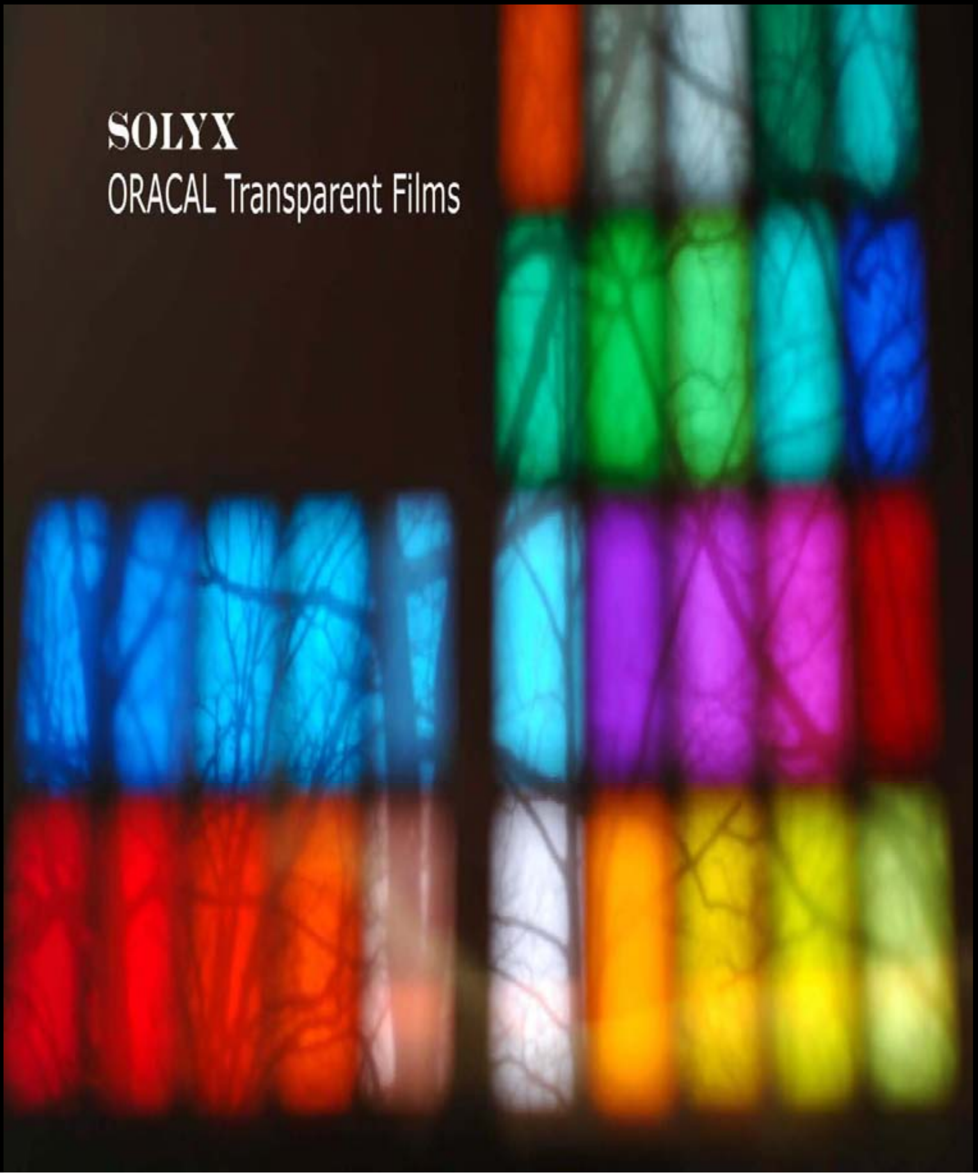


Common wind tunnel controls

- Interlocks
  - Some wind tunnels do not have laser interlocks but have personnel safety interlocks due to other hazards
- Access controls and training of wind tunnel technicians
- Control rooms may require additional protection if they have viewing windows

Window protection

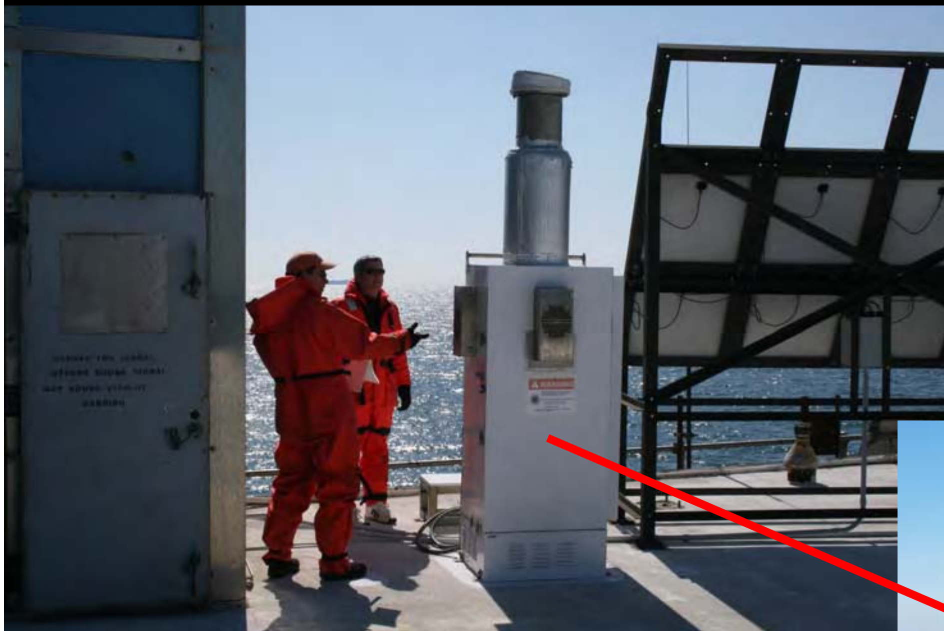
- Architectural decorative window films
- Order samples in the colors you think will work
- Test in spectra-photometers
- Can usually get OD >3. Adequate for diffuse hazards



Ground based lidar

- We have approximately 12 ground based lidars
- Some are portable and/or “flyable”, some are fixed and some are remote autonomous systems

COVE MPL



About MPL

- Class 2M autonomous lidar installed on the Chesapeake Light Tower, 14 NM out to sea.
- Runs 24 hours a day (unless broken) and controlled via wireless internet
- Annual visit by myself. There's tons of other hazards out there also so it's a full day inspection.
- FAA was provided a courtesy notification about its use but a formal review was not requested.

How do you get there?

On center lidar

- We have 7 laboratories set up for doing ground based lidar. 6 are vertical, 1 is horizontal
- Aside form normal lab controls such as interlocks we also utilize radar interlocks for aircraft detection when required.
- FAA and laser clearinghouse submissions, if required

Examples

Airborne lidar

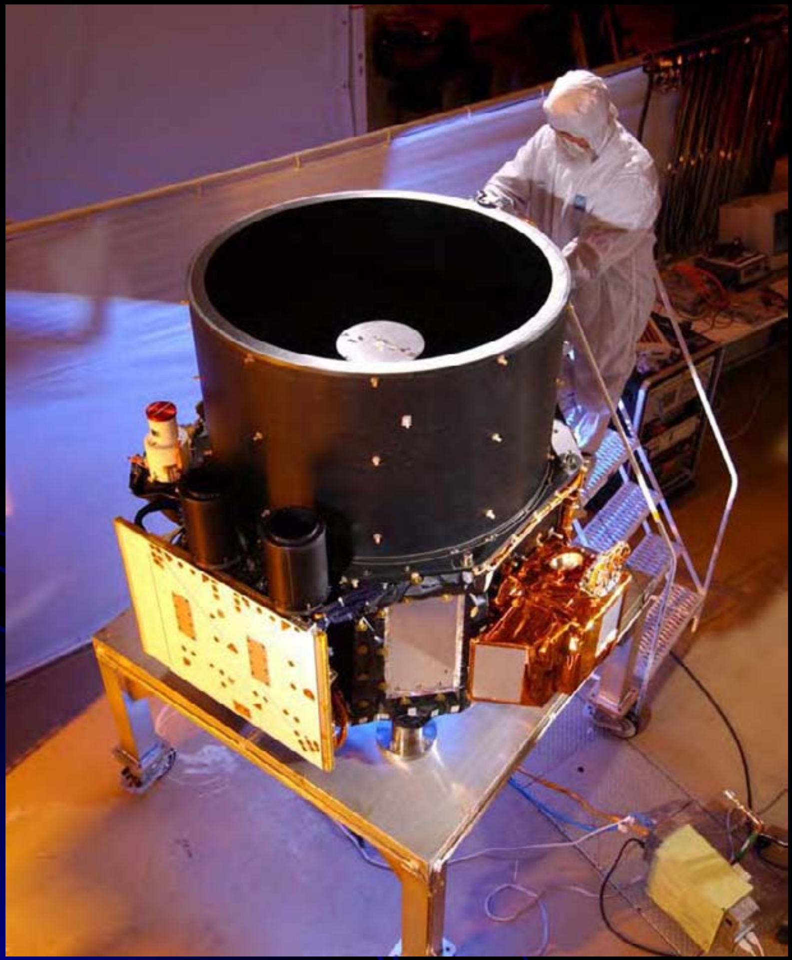
- Many of our ground based systems are also designed to operate from aircraft
  - NASA DC-8, NASA King Air Be-200, L3 Comm. Lear Jet, Copmm. Helicopters
- Some transmit in only to zenith or nadir, some do both

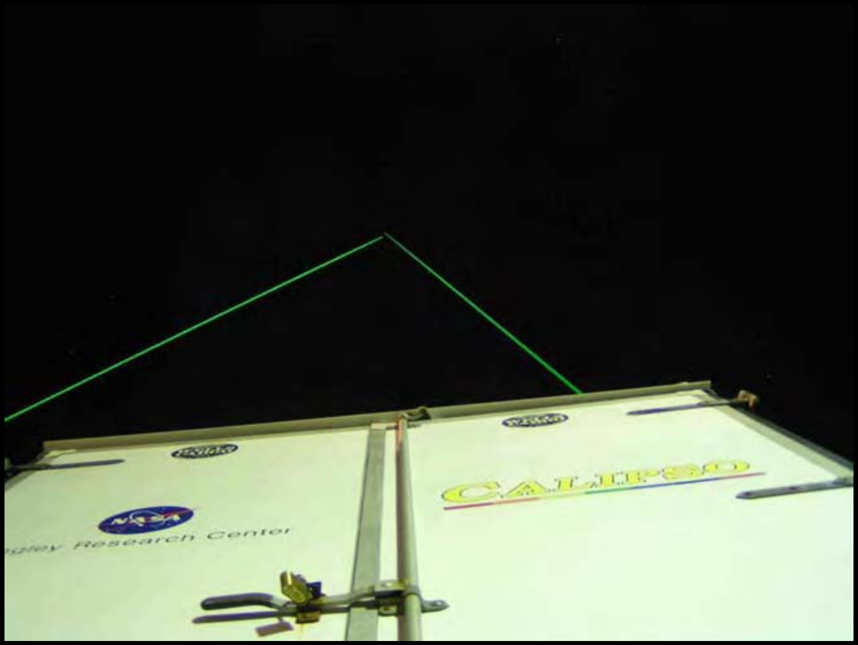
Airborne controls

- Must be eye safe on ground
- TCAS radar if available
- Safety observers in the airplane
- Flight route to avoid overflying airports
- Flight safety review
  - Ensures buy-in from flight crews
- FAA submissions – These continue to be highly problematic

Airborne lidars

CALIPSO





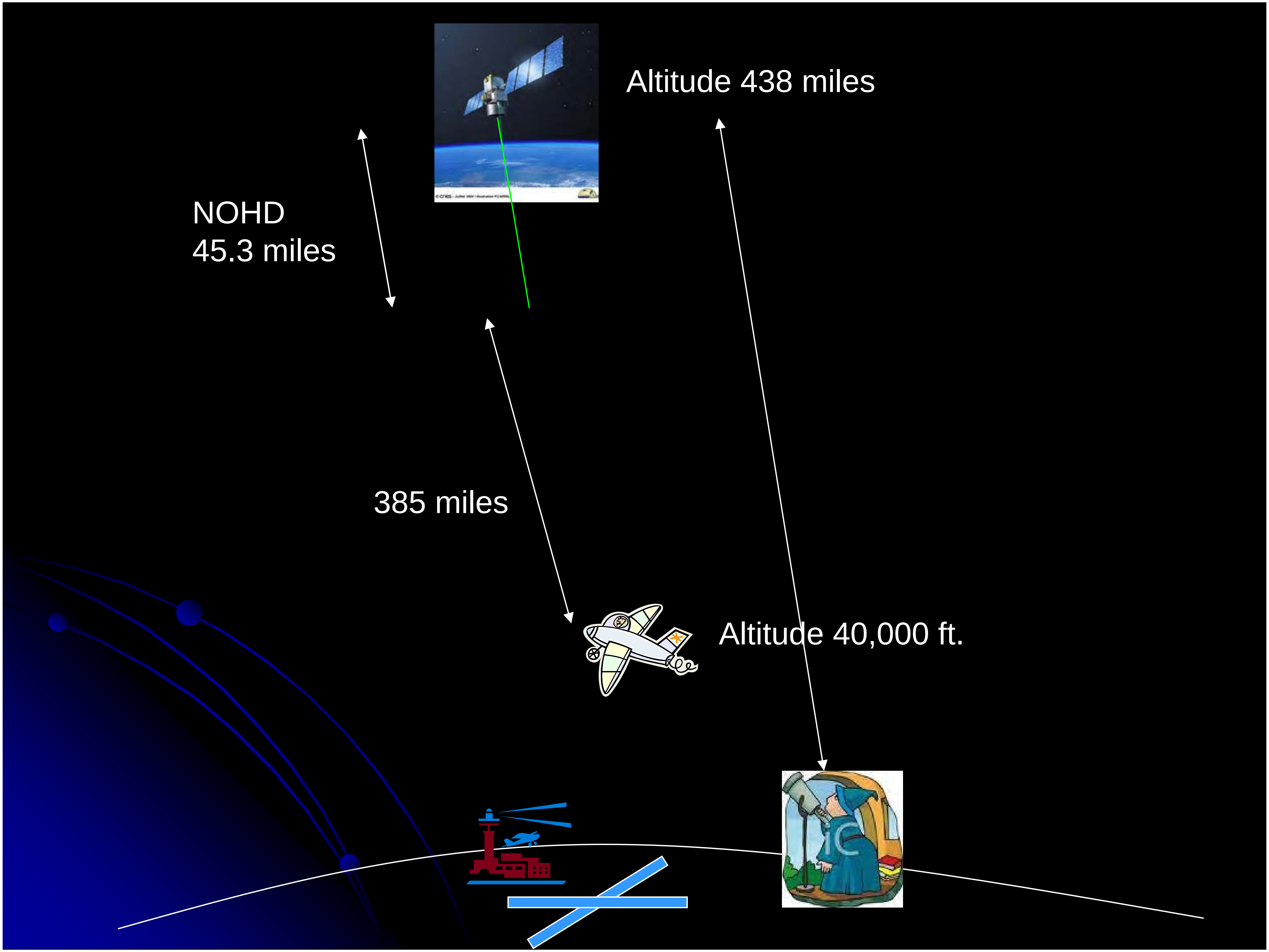
It's in space now so no more worries right?

WRONG!

- Last year we started to here rumors of people claiming to have been “exposed” to it
- Ground track data was available on line for science community
  - This allows you to know where it will be as well as where it was, so you could sit out there in the path and try to look at it
  - Although below MPE on the ground we did determine that there was a potential hazard if viewed with a telescope
- We altered the ground path information to reduce the accuracy. We made a conscious decision NOT to post a hazard warning on the CALIPSO web site.

You shouldn't be able to see something over 400 miles away right?

How do you explain something like this to management?


Altitude 438 miles
NOHD
45.3 miles
385 miles
Altitude 40,000 ft.

Problem areas

- FAA
  - We continue to have issues with both the timeliness and overly restrictive outcomes
- Training
  - I usually have about 1/4 of my laser workers out of date on refresher training
- New operations cropping up
  - This is a recent phenomenon. Trained users are supposed to know that I have purchase control over laser systems.

Laser hazard analysis software

Experience

- I have been using Lazan for probably 10 years
- I have been using LHAZ Ver. 4 for about 6 years
- LHAZ Ver. 5 just came out (or has it)

Pro’s

- Regardless of which you use it allows you do calculations quickly and with repeatable results
- If you take the time you can actually program all of your lasers into the software so you just pull it up and make changes as necessary
- You can disengage your brain and still get work done

Con’s

- Relying on the software alone leads to some knowledge atrophy in how the answers are derived
- The software may not be set up do to exactly what you need
  - FAA calcs
  - Mode locked pulse bursts
  - Multi wavelength lasers with fractional MPEs

Lazan

- Relatively easy to use
- No aided viewing conditions
- Must add new lasers to the library if you are working with a wavelength that is not already programmed in
- Does have a nice print out report
- User defined laser data base is pretty nice if you decide to use it

LHAZ Ver. 4

- Easy to use
- No need to add lasers, it just uses wavelength
- Ability to get NOHDs in different units
- Aided viewing as well as outdoor NOHDs with atmospheric attenuation
- Gives all MPEs in mJ/cm2. Nothing really wrong with that but I prefer them in mW/cm2
- Graphing function never worked on my copy

LHAZ Ver. 5

- Different layout from Ver. 4. I think it may be a bit harder to use but you have more parameters to play with (not always a good thing)
- The new graphing functions are nice
- Haven't had the work load to really try and break it yet

GSFC Outdoor Laser Safety

T. Simmons

Goddard Flight Research Center

5/16/2008

NASA GSFC
Laser Safety Program

Health Physics Conference
May 2008 Cocoa Beach

Laser Safety Program Scope

- 251 Class 3b and Class 4 lasers
  - 24 used in navigable airspace (FAA)
  - 7 used in non-navigable airspace
- 152 Registered laser users
- 45 Certified laser labs/projects

Roles and Responsibilities

- Custodian:
  - AKA – Principle Investigator, Authorized User
  - Responsible for accountability
  - Responsible for safe use and storage
  - Responsible for all users in their lab or on their project
- User:
  - Must know and follow safety requirements
  - Must follow policies and procedures
  - Must use personal protective equipment when required
  - Must be familiar with the specific hazards of the laser used
  - Must immediately report unsafe conditions or operations to their custodian, Facilities Operations Manager or Laser Safety Officer

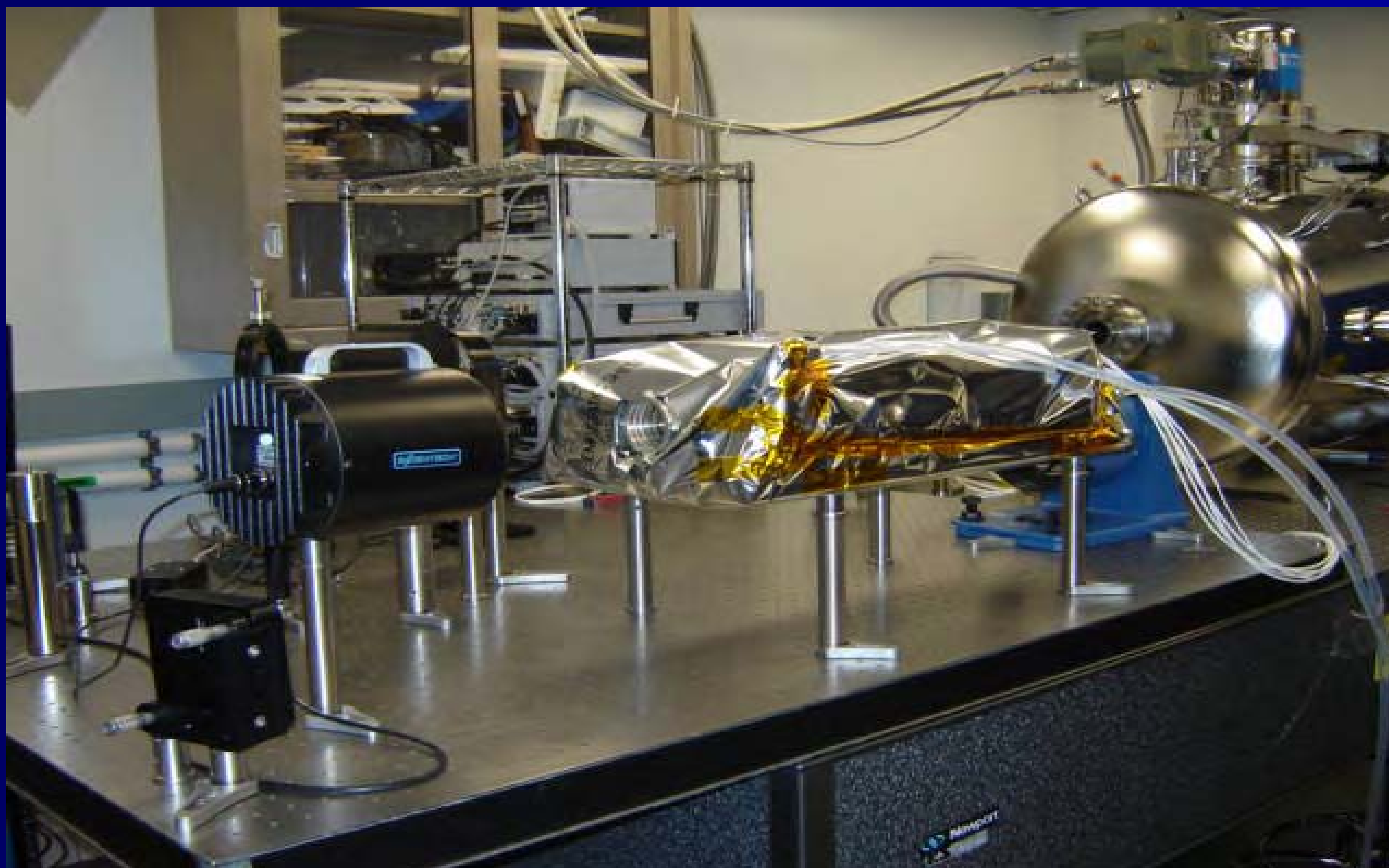
Roles and Responsibilities

- GSFC Laser Safety Officer
  - Inspect laser radiation use and storage areas
  - Audit and maintain inspection/evaluation records
  - Authorized to require cessation of operations when required
  - Provide consultation on Class 3b and Class 4 laser operations
- Management
  - Responsible for physical safety of personnel
  - Must assure that only approved personnel operate lasers
  - Must insure warning signs are procured and posted
  - Responsible for all Class 1, 2, 3a laser safety

Roles and Responsibilities

- GSFC Radiation Safety Committee (RSC)
  - Comprised of representatives from various directorates
  - Responsible to the Goddard Safety Council for overseeing development, direction and implementation of the GSFC Radiation Protection Program
  - Laser Safety Sub-Committee (LSSC) meetings held quarterly
  - Approve uses and users of Class 3b & Class 4 lasers
- Supervisors
  - Responsible for employees and projects
  - Must insure equipment is properly maintained
  - Must insure personnel are trained and knowledgeable

Laser Operations Approval Requirements



Laser Operations Approval Requirements

- Laser Radiation Source Approval
  - GSFC Form 23-6L (Class 3b & Class 4)
    - Approvals expire after three years
  - FAA Form 7140-1 for outdoor laser use in navigable air-space *(may include Class 1 laser)*
- Personnel Approval
  - GSFC Form 23-35LU (Class 3b & 4 only)
    - **Preplacement (Baseline) eye exam required**
    - **Approvals expire after three years**
    - **LSO will issue a certification card which must be kept by the laser user (OSHA Requirement)**
- User Certification
  - Users of Class 1, 2 & 3a lasers obtain certification from line management

Laser Operations Approval Requirements

- Laser Installation
  - GSFC Form 23-28L is completed by the laser custodian and submitted to the LSO with the GSFC Form 23-6L
  - A Form 23-28L is only prepared once
  - A Form 23-6L is usually completed for each project/program or lab using lasers

Training Requirements

Training Requirements

- Course A
  - Basic Understanding of Laser hazards
  - Understand warnings, hazards, & use instructions
  - Usually provided by management and/or the custodian

- Course B *(Includes Course A plus):*
  - Read GPR 1860.2A
  - Know user responsibilities & use approval procedures
  - Understand RSC imposed requirements
  - Understand consequences of violations
  - The remainder of this course is satisfied by completion of the course of laser safety instruction through the SATERN training web site.

Training Requirements

- Course C *(Includes Course B plus):*
  - Understand advanced laser math
  - Know beam characteristics & measurement
  - Know hazard zone determinations
  - Understand laser protective eyewear selection
- Outdoor Laser Operations *(Includes Course C plus):*
  - In-depth knowledge of laser safety including non-damaging visual effects, emission calculations, and engineering controls
  - Understanding operating procedures and safety requirements of the laser installation.
  - Able to complete FAA Form 7140-1

Training & Experience Requirements for Users

Table 3-1
Laser User Training and Experience Requirements

Laser Class	Course	Experience*	Approval Authority
1	-	None	Management
2	A	Hands-On Instruction	Management
3a	A	Hands-On Instruction	Management
3b	B	1 Week operational	RSC
4	B	1 Month operational	RSC

** Other requirements may be substituted for experience as determined appropriate by the RSC.*

Training and Experience Required for Custodians

Table 3-2
Laser Custodian Training and Experience Requirements

Laser Class	Course	Experience*	Approval Authority
3b	C	1 Week	RSC
4	C	1 Month	RSC
Outdoor Laser Operations	C+**	6 Months	RSC

** Other requirements may be substituted for experience as determined appropriate by the RSC.*

*** Training requirements are specified in GPR 1860.2A, Section 3.d.*

Baseline and Termination Eye Examinations

- Recommended by ANSI Z136.1-2007
  - Ocular History
  - Visual Acuity Test
  - Macular Function Test
  - Color Vision Test

    (If results from above tests are abnormal, more in-depth evaluation may be required)

Inspection Requirements

- Line Management (Class 1, 2, & 3a)
  - – Inspect for alterations
  - – Personnel training up-to-date
  - – Document inspection for LSO audit
- LSO (Class 3b & Class 4)
  - – Reviewed prior to start-up
  - – Reviewed after any alterations
  - – Unannounced audits conducted

Outdoor Laser Operations

Outdoor Laser Operations

- ANSI Z136.6-2005
- Safety Hazard Analysis
- DoD Laser Clearing House Approval for certain systems directed toward outer space
- FAA letter of non-objection for lasers transmitting in navigable air space

  NOTE: "No laser system having a Letter of Objection from the FAA shall operate." (Ref: GPR 1860.2A)
- Evaluation of outdoor operations
  - responsibility of the user organization. *(The LSO will assist with technical guidance and review)*

Optical Fiber Communication Systems

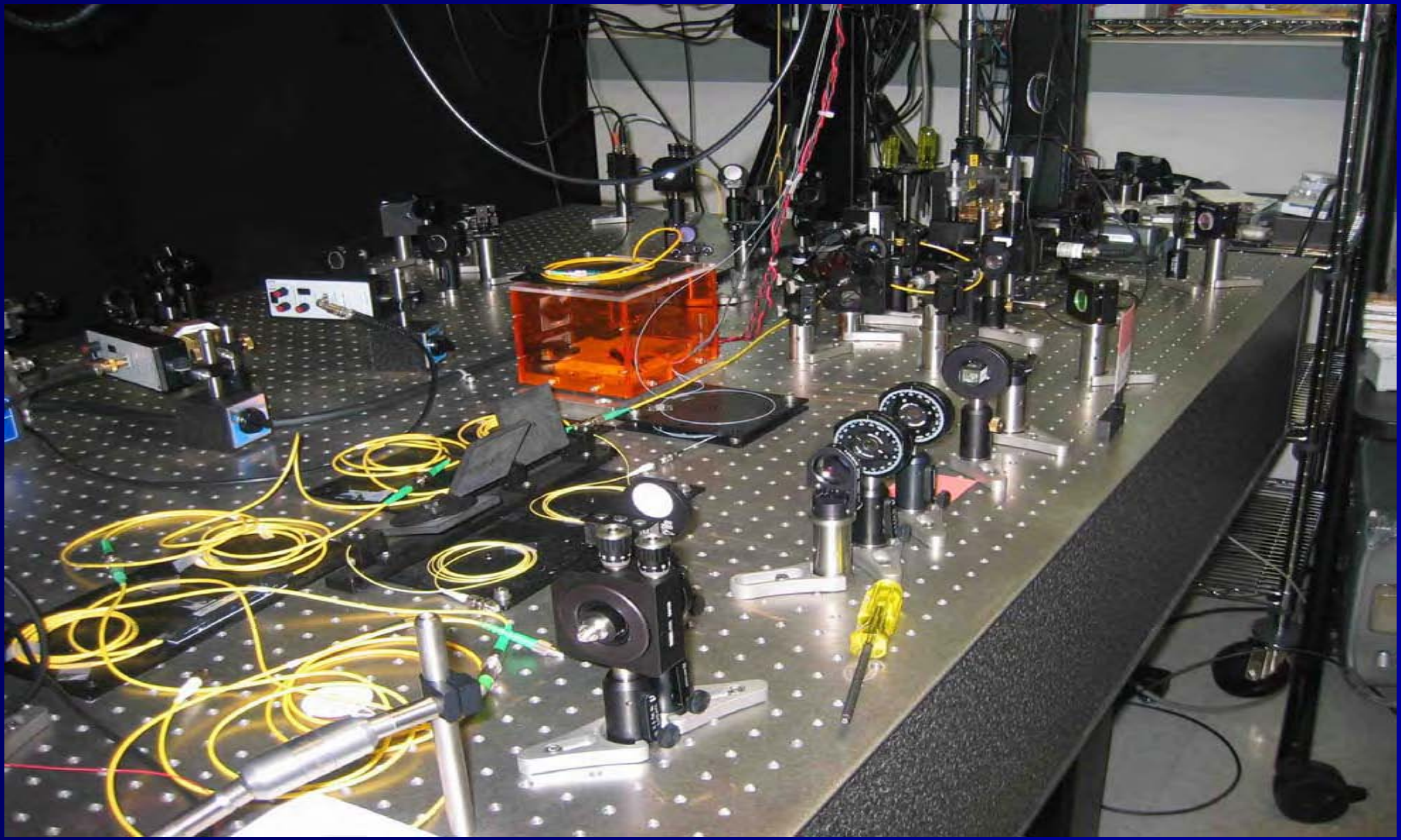
- Must follow guidelines established in ANSI Z136.2
- RSC approval must be obtained for these systems (GSFC Form 23-6L)

Off-Site Laser Operations

Off-Site Laser Operations

- Subject to requirements of the use site
- Appointment of a site laser safety officer for the project who has the authority to insure that safe operations are conducted and that local regulations are met.

Laser Radiation Protection Requirements



Laser Radiation Protection Requirements

- ANSI Z136.1-2007
  - Reference Table 10 for control measures
  - Alternate control measures may be approved only by the RSC with adequate justification
  - Protective eyewear should only be used after all engineering controls have been exhausted
  - Non-Beam Hazards
    - Electrical
    - Air contamination
    - Hazardous Waste
    - Confined spaces
    - Ergonomics
    - Plasma radiation
    - Fire/explosion
    - Compressed Gas
    - Laser dyes
    - Hazardous Noise

Caution Signs, Symbols, Labels and Posting

- Signs, symbols and labels must comply with ANSI Z136.1

- User may provide on or near such signs any information that may be appropriate in aiding individuals to minimize exposure
- SOP must be posted on or near the laser control panel or at the entrance to the laser facility

NASA-GSFC Unique Location

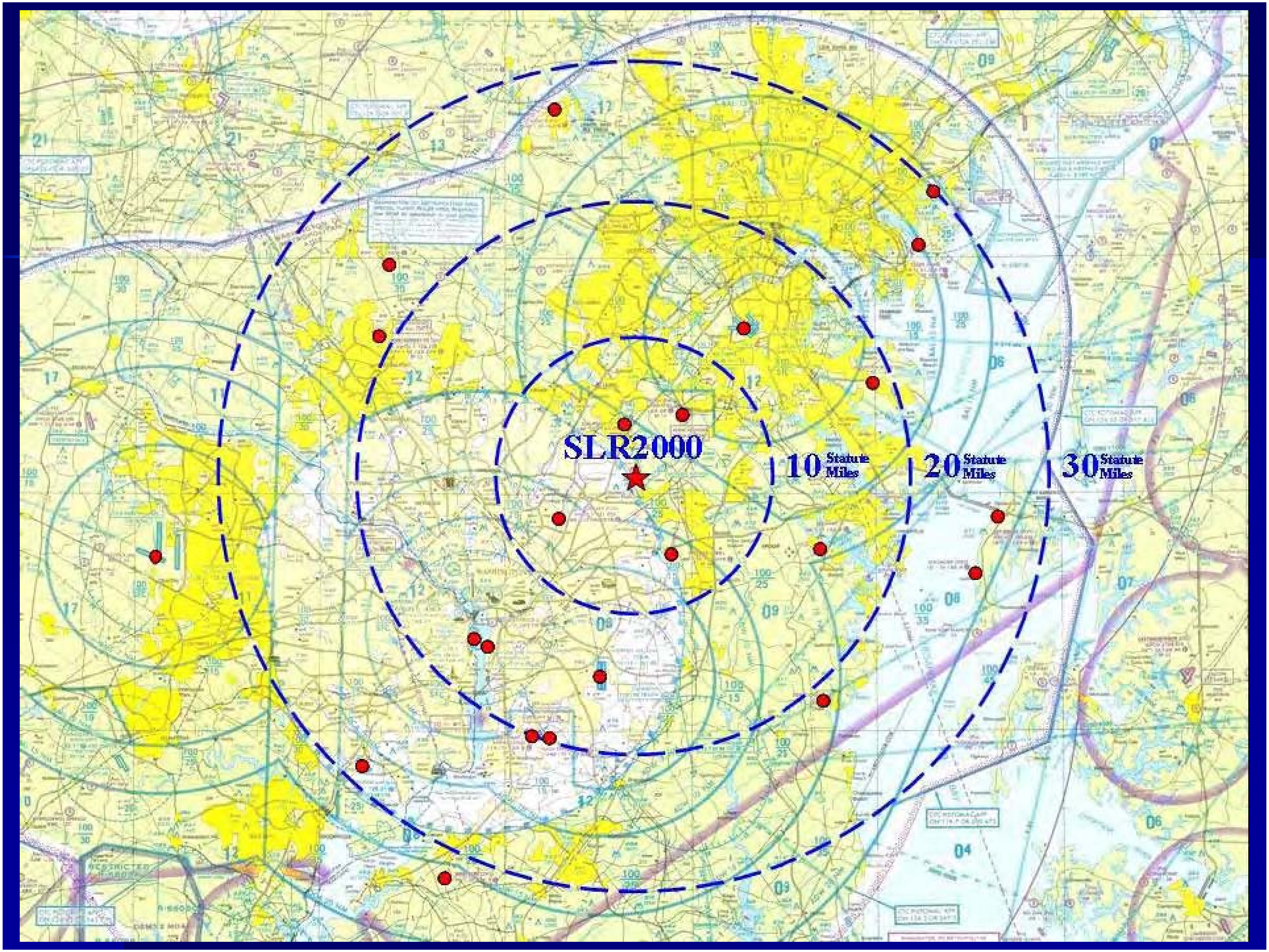
Two laser sites

1. Greenbelt (Main Campus)

2. Goddard Geophysical and Astronomical Observatory (GGAO)

- Only a few miles apart

- Less than 12 miles from the White House


SLR2000
10 Statute Miles
20 Statute Miles
30 Statute Miles

Location challenges

- 24 airports within 35 mile radius
  including National, BWI and Dulles
- Need to identify Laser Free Zones, Critical Zones and Sensitive Zones around these airports relative to Goddard laser activities
- A lot of air traffic to consider for any outdoor laser operations

DoD coordination

- Department of Defense coordination required in addition to FAA
  - Any laser greater than 0.1 mW/cm2 at 60K feet.
- MLA earth uplink communication experiment needed to be coordinated with DoD. Restrictions impacted experiment.

GGAO Satellite Laser Ranging

- NASA MOBile LAser Ranging System's (MOBLAS 4,5,6,7,8) operating since early 1980’s with no FAA issues
- MOBLAS 7 at Goddard GGAO site
- Next Generation Satellite Laser Ranging system (NGSLR)
  - NGSLR supports the Lunar Reconnaissance Orbiter
  - Currently seeking FAA Letter of Non-objection

MOBLAS 7 operating at GGAO

NGSLR located at GGAO

Laser Critical Zone

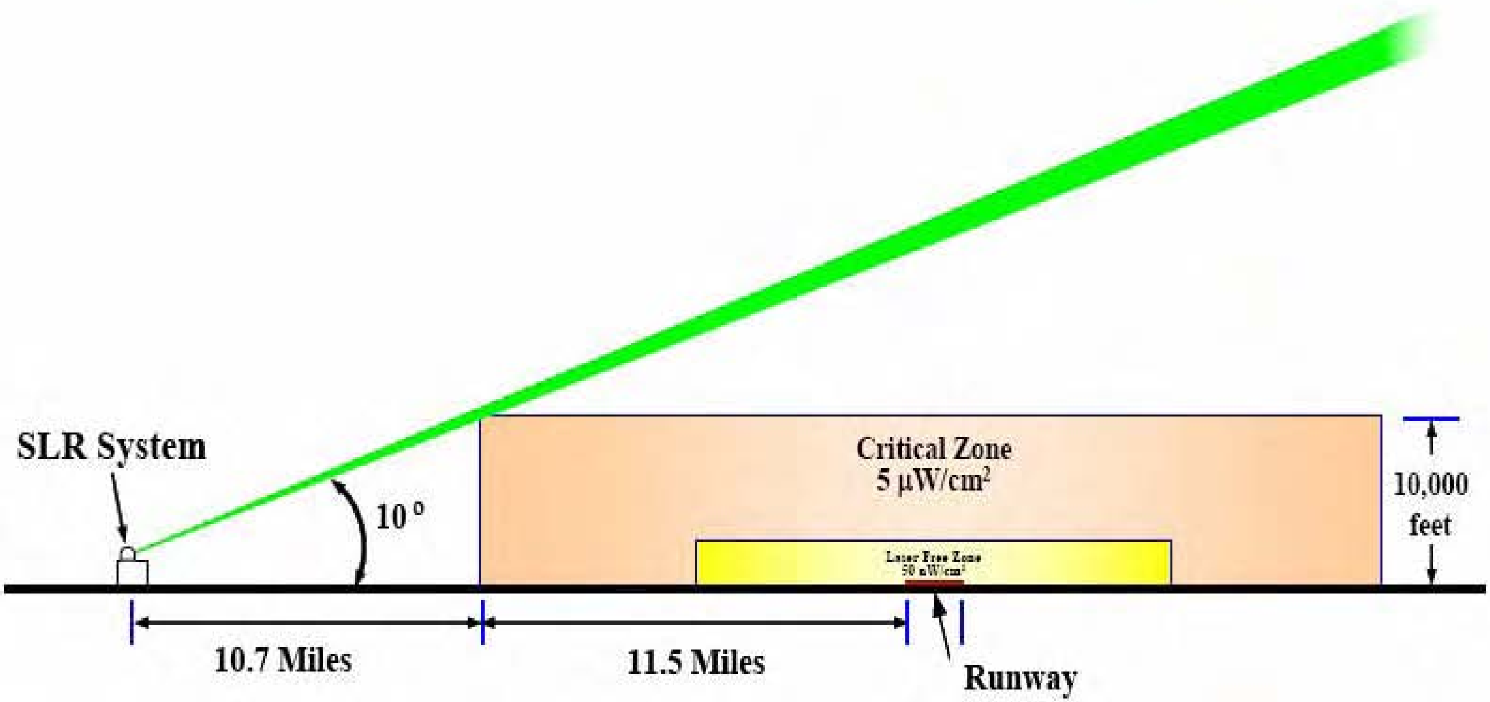


Figure 15 – Critical Zone Penetration Conditions

Laser Free Zone

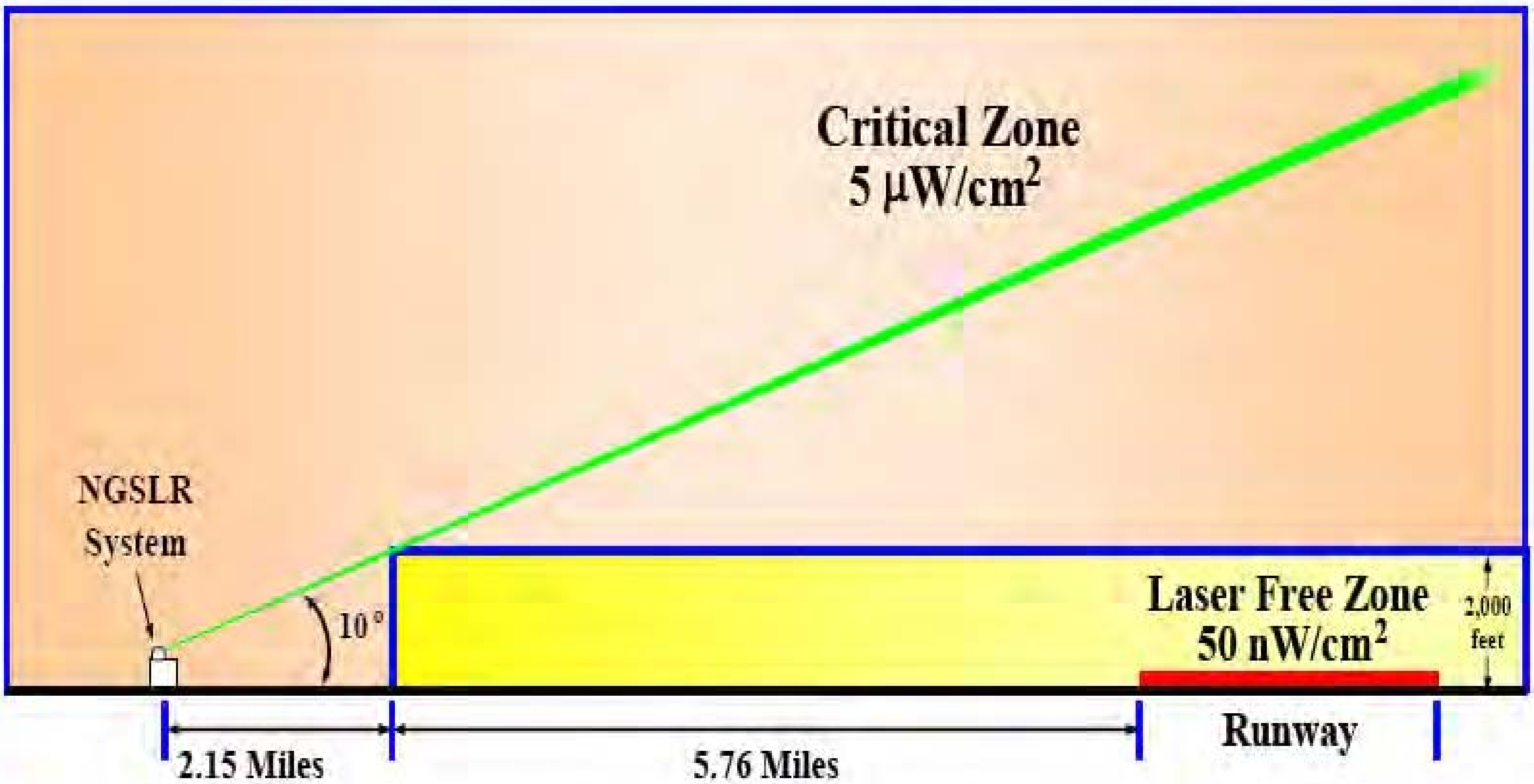


Figure 16 – Laser-Free Zone Penetration Conditions

GSFC off site laser use

Co2 Sounder Experiment deployed to Denver

Co2 Sounder Experiment laser inside van

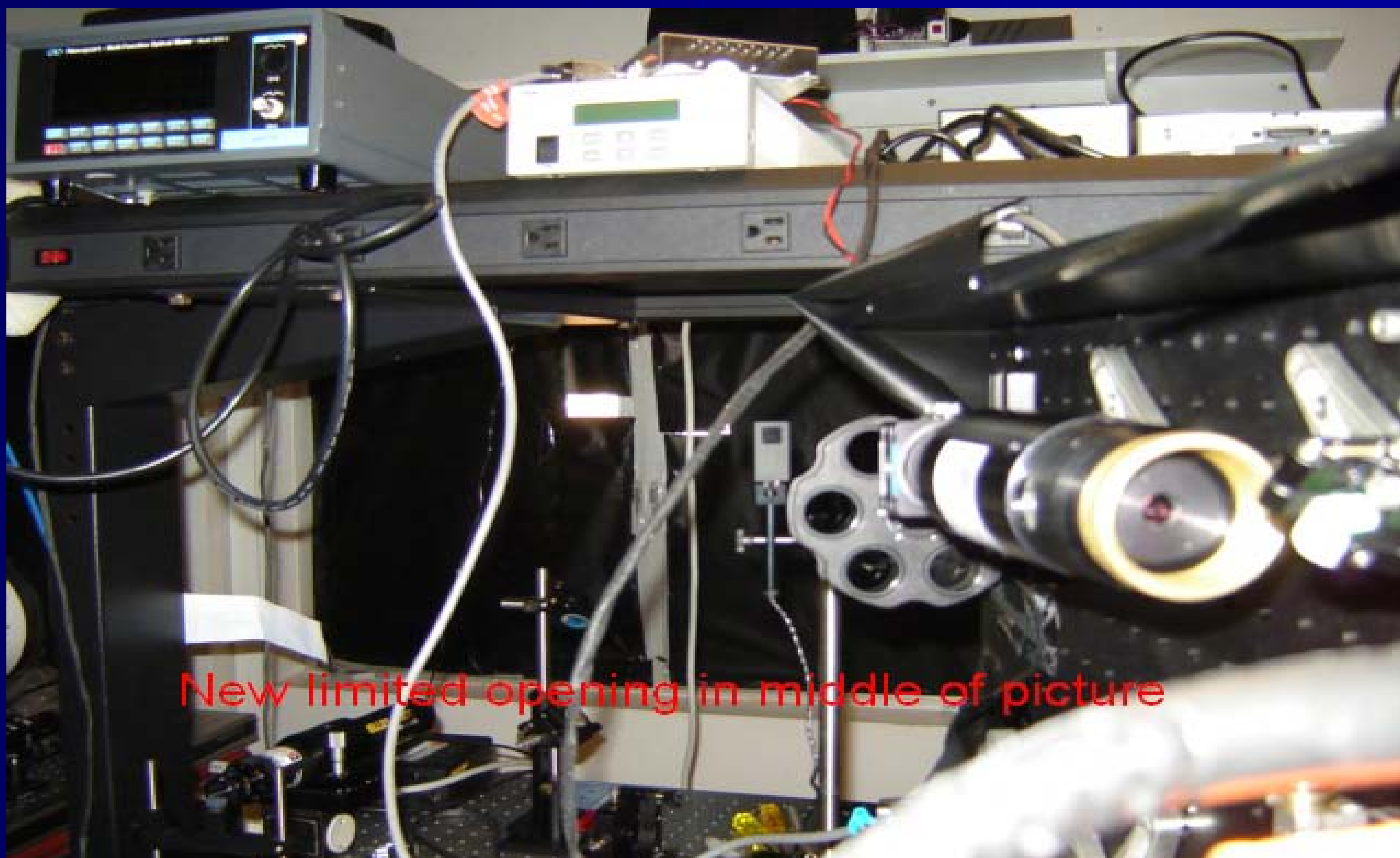
Perceived problems and resolution

- Education an important tool in a successful laser safety program

Perceived problems and resolution - example

- Experiment lasing over another NASA building to water tower
- Laser light seen on wall over office during meeting
- Creates concern for meeting attendees
- Laser Safety Office investigates
- Eye safe laser approved by Radiation Safety Committee
- Laser had “slipped” in fixture
- Made recommendations to eliminate possible future occurrences

Perceived problems and resolution – Pushbroom II



Questions/comments

GSFC Laser Safety Program

Ted Simmons
Laser Safety Officer
NASA-GSFC
8800 Greenbelt Road
Greenbelt, MD 20177
301-286-7367
theodore.d.simmons@nasa.gov

GSFC HP Program:
Source Inventory

D. Simpson

Goddard Flight Research Center

5/16/2008

Goddard Space Flight Center

GSFC HP Program

Source Inventory Database

Dan Simpson

Radiation Safety Officer

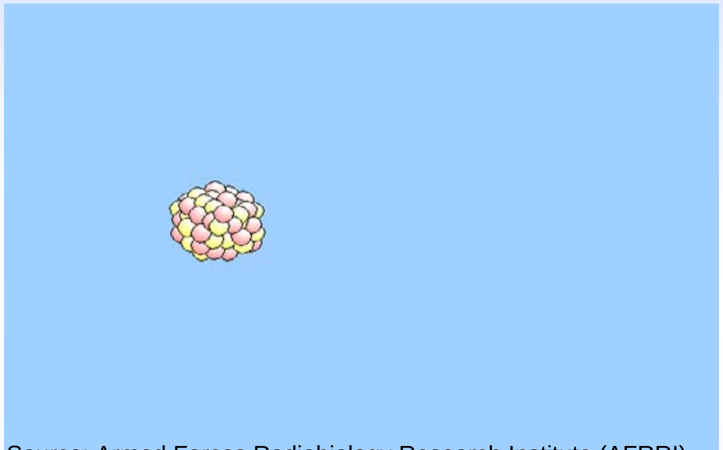
Goddard Space Flight Center (GSFC)

Daniel.S.Simpson@nasa.gov

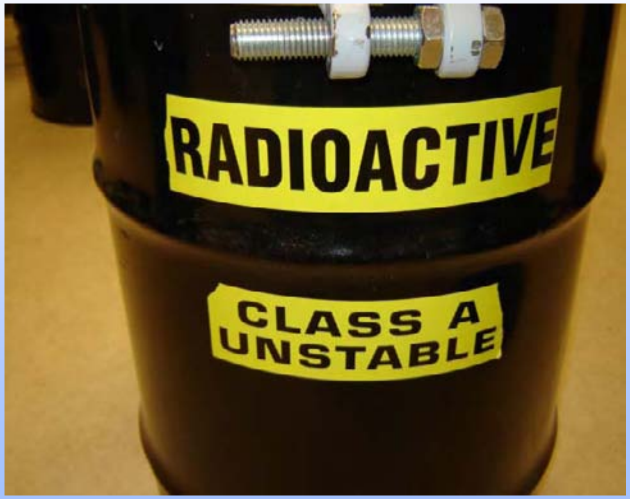
Goddard Space Flight Center

Radiation Protection Office (RPO)
Code 250.2

- **Ensures GSFC remains in compliances with our two Nuclear Regulatory Commission (NRC) radioactive material licenses**



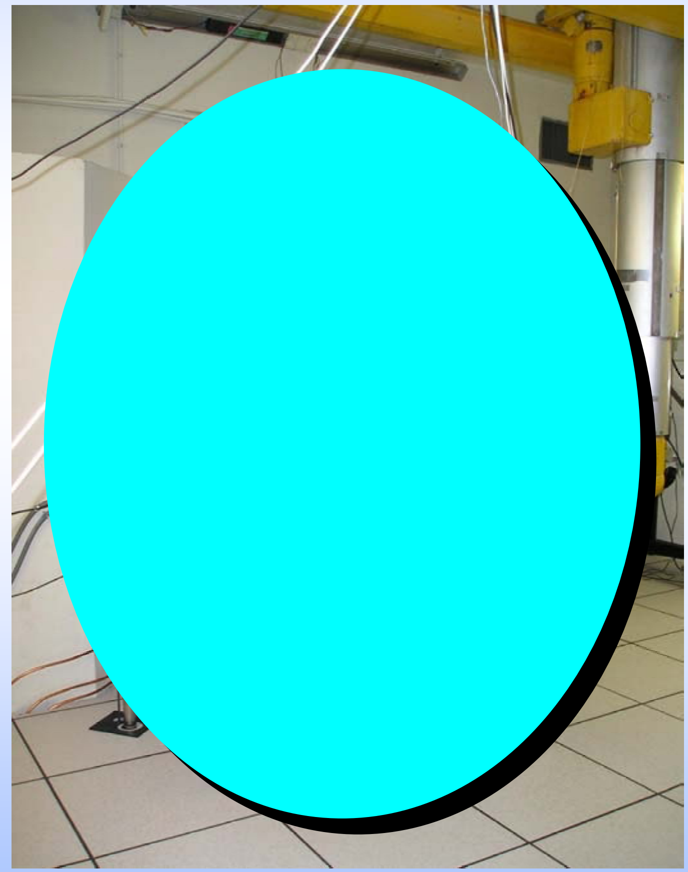
Source: Armed Forces Radiobiology Research Institute (AFRRI)



Goddard Space Flight Center

Radiation Effects Facility

- **Type of Source Being Used**
- **INCREASED CONTROLS**



Radiation Protection Office (RPO)
Code 250.2

Goddard Space Flight Center

- Supports GSFC Projects by:
  - Shipping, Receiving, and Transfer of Radioactive Sources
  - Inspection and Survey of Source Use Areas
  - Radioactive Waste Disposal and Source Storage
  - Maintenance, Repair, & Calibration of Radiation Detection Instruments
  - Inventory of Radioactive Sources

Radiation Protection Office (RPO) Code 250.2

- Actively providing radiological support for the Lunar Exploration Neutron Detector (LEND) project and Comic Ray Telescope for the Effects of Radiation (CRaTER) project, which will be flow on the Lunar Reconnaissance Orbiter spacecraft.

Goddard Space Flight Center

RS Solutions Database

Goddard Space Flight Center

RS Solutions Database

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Authorized User's Rad Workers

Active Radiation Workers

AU: Bradley, Jung

Name	Phone Number	Email Address	Local Address	Permanent Address
Blackman, Hosoon	(404) 555-4940	Hosoon.Blackman@college.edu	123 Blackman Road Atlanta, GA 30332	123 Hosoon Drive Atlanta, GA 30332
Desai, Jung	(404) 555-8423	Jung.Desai@college.edu	123 Desai Road Atlanta, GA 30332	123 Jung Drive Atlanta, GA 30332
Kropewnicki, Lisa	(770) 555-8909	Lisa.Kropewnicki@college.edu	123 Kropewnicki Road Atlanta, GA 303320230	123 Lisa Drive Tyrone, GA 30290
Marshall, Phillip	(404) 555-8952	Phillip.Marshall@college.edu	123 Marshall Road Atlanta, GA 30332	123 Phillip Drive Atlanta, GA 30309
Wilson, Ying	(404) 555-9509	Ying.Wilson@college.edu	123 Wilson Road Atlanta, GA 30332	123 Ying Drive Atlanta, GA 30332

Workers Training

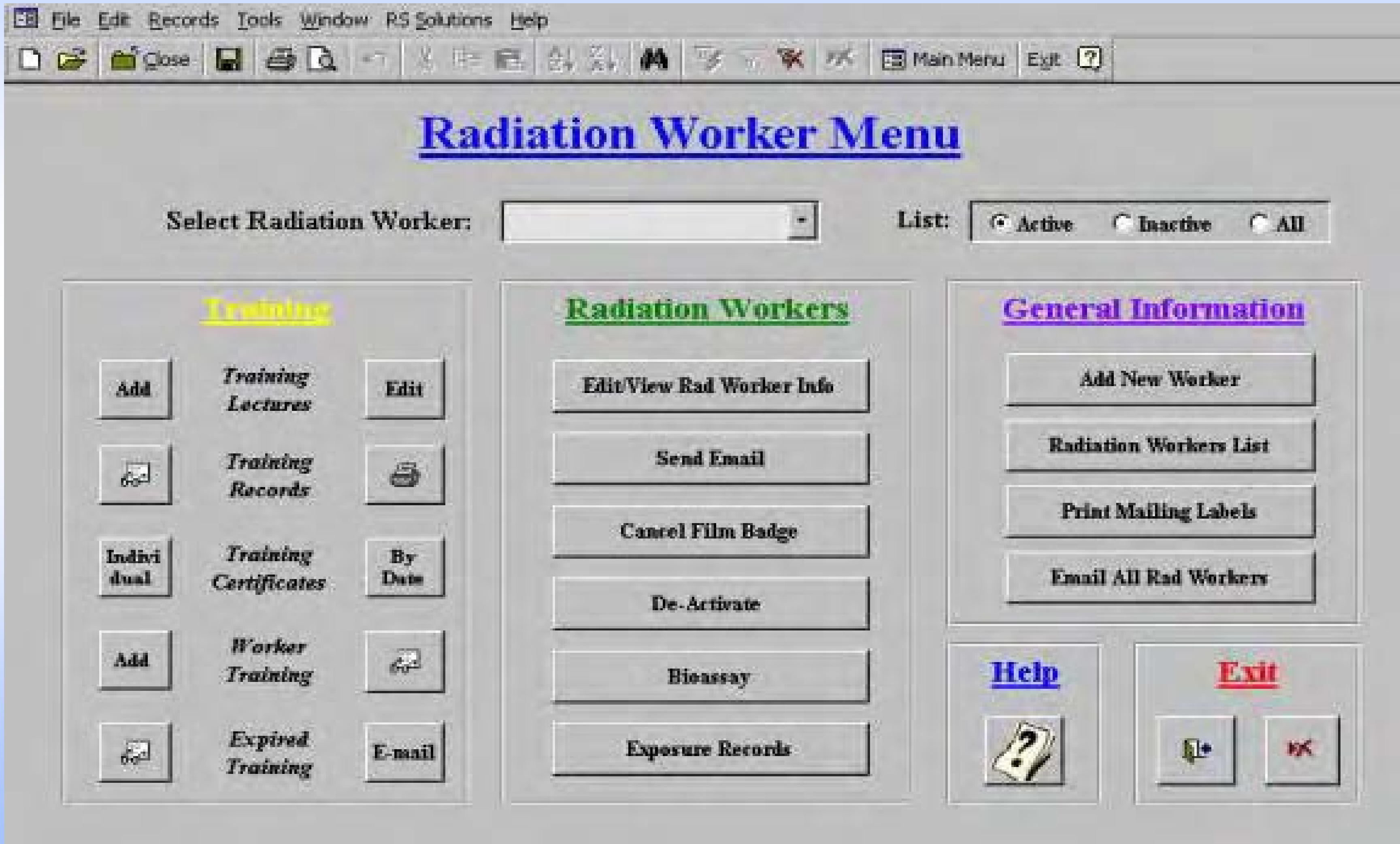
Expired Training

List of Radiation Workers that require Refresher Training:

Name	Type	Basic Training Lecture Date	Type	Last Refresher Training Lecture Date	Email Address	Phone Number
Alexiou, David	RAM	5/15/97			David.Alexiou@college.edu	(404) 555-2846
Amburgey, Joseph	RAM	7/ 7/94	RAM	1/16/99	Joseph.Amburgey@college.edu	(404) 555-9366
Appiah, Ahmet	X-Ray	7/ 7/94	X-Ray	2/26/99	Ahmet.Appiah@college.edu	(404) 555-6817
Aramis, Kurt	RAM	3/13/91			Kurt.Aramis@college.edu	(404) 555-9365
Bai, Johannes	RAM	11/15/95	RAM	1/16/99	Johannes.Bai@college.edu	(404) 555-3605
Bai, Johannes	X-Ray	11/11/95			Johannes.Bai@college.edu	(404) 555-3605
Barnes, Robert	RAM	8/ 9/94	RAM	1/16/99	Robert.Barnes@college.edu	(404) 555-0339
Batth, Inge	RAM	12/ 3/96			Inge.Batth@college.edu	(404) 555-
Bayer, Cheng	RAM	4/ 8/93			Cheng.Bayer@college.edu	(404) 555-3269
Berta, John	RAM	10/10/96			John.Berta@college.edu	(404) 555-6368
Beydilli, Myrna	RAM	6/29/95			Myrna.Beydilli@college.edu	(404) 555-1854
Biz, Gary	RAM	6/29/95			Gary.Biz@college.edu	(404) 555-0202
Black, Richard	RAM	1/20/94	RAM	1/16/99	Richard.Black@college.edu	(404) 555-0338
Blackman, Hosoon	RAM	10/ 6/94	RAM	1/16/99	Hosoon.Blackman@college.edu	(404) 555-4940
Blaylock, Kevin	RAM	3/25/97			Kevin.Blaylock@college.edu	(404) 555-5956
Chen, Steve	X-Ray	10/ 5/95	X-Ray	2/26/99	Steve.Chen@college.edu	(404) 555-6345
Cheng, Donald	X-Ray	9/ 1/74			Donald.Cheng@college.edu	(404) 555-8517
Chernoff, Thomas	RAM	5/ 2/94			Thomas.Chernoff@college.edu	(404) 555-8419
Chesla, Jesse	RAM	5/ 2/73	RAM	1/16/99	Jesse.Chesla@college.edu	(404) 555-3994

Goddard Space Flight Center

RS Solutions Database



Goddard Space Flight Center

Worker Training Certificates

United States University

This is to certify that

Howell, Edgar

has attended and satisfactorily passed an examination covering

the contents of 3-hour training program entitled:

Basic RAM SAFETY

presented by the

Office of Radiological Safety

12/11/96	*12/11/99*	
Training Date	***Expiration Date***	***Radiation Safety Officer***

Bioassay Reports

Goddard Space Flight Center

Bioassay - Radiation Worker

Howell, Edgar

Year: 1999

Sample Date	*Sample Time*	*Reason for sample*	*Organ*	*CEDE (mRem)*	*CDE (mRem)*
12/24/99	10:00	Annual	Whole Body	85	85
10/10/99	11:00	Beginning of Employment	Whole Body	0.25	0.25

Committed Effective Dose Equivalent (CEDE) = 85.25 *mRem*

Committed Dose Equivalent, Maximally Exposed Organ (CDE) = 85.25 *mRem*

Year: 2000

Sample Date	*Sample Time*	*Reason for sample*	*Organ*	*CEDE (mRem)*	*CDE (mRem)*
3/23/00	8:00	RWP-2000-04	Whole Body	0.15	0.15
3/9/00	9:40	Annual	Whole Body	292	292
2/25/00	14:00	RWP-2000-03	Thyroid	0.15	5000
2/5/00	13:00	RWP-2000-02	Thyroid	0.1	3333
1/10/00	12:00	RWP-2000-01	Whole Body	0.015	0.015

Committed Effective Dose Equivalent (CEDE) = 292.415 *mRem*

Committed Dose Equivalent, Maximally Exposed Organ (CDE) = 8333 *mRem*

Fetal Exposure Records

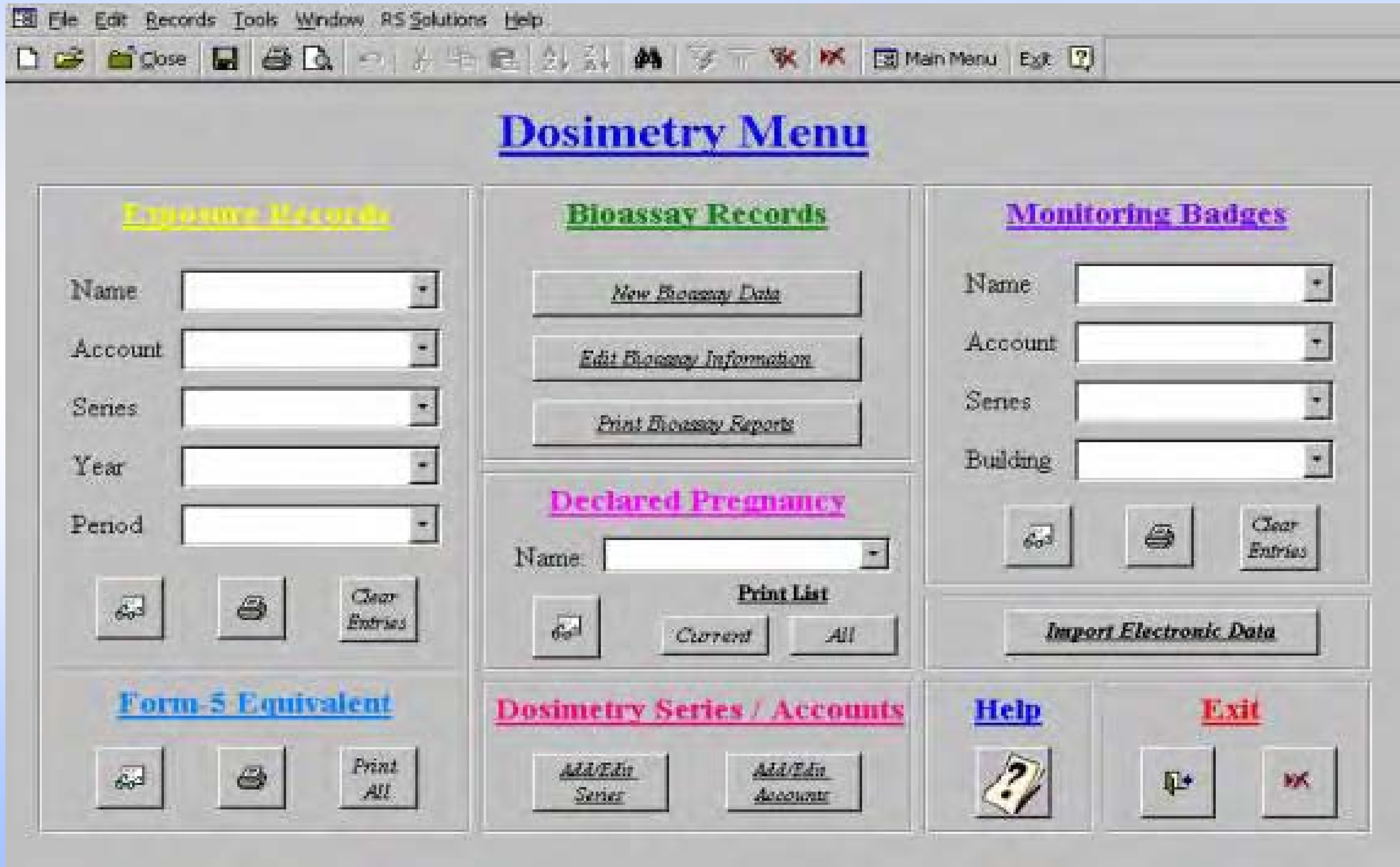
Fetal Exposure Records

Account Number : *021542*

Name	*Declaration Date*	*Conception Date*	*Badge Number*	*Series*	*Period Ending*	*Fetal Dose (Rem)*	*Phone Number*	*Permanent Address*
Alison Almonacil	10/10/99	8/13/99	05499	STU	3/31/00	0.02	(770) 555-1428	123 Alison Drive Cumming GA, 30041
Marisa Alou	1/10/00	12/1/99	05466	DEF	6/30/00	0.065	(404) 555-0263	123 Marisa Drive Atlanta GA, 30332

Goddard Space
Flight Center

RS Solutions Database



Goddard Space Flight Center

Dosimetry Reports

United States University

Radiation Dosimetry Report

Account Number: 021542

Series: JKL

Name	*Participant Number*	*Dosimeter Type*	*Dosimeter Use*	*Period Begin date*	*Period End date*	*Current (mrem)*			*Year to Date (mrem)*			*Lifetime (mrem)*		
						DDE	*LDE*	*SDE*	*DDE*	*LDE*	*SDE*	*DDE*	*LDE*	*SDE*
Russell Chow-Quan	05459	C1		1/1/00	3/31/00	0	0	0	0	0	0	90	90	90
Russell Chow-Quan	05459	U3		1/1/00	3/31/00			40			40			40
Shelley Ikeda	05472	C1		1/1/00	3/31/00	0	0	0	0	0	0	20	20	20
Anthony Li	05462	C1		1/1/00	3/31/00	0	0	0	0	0	0	70	70	70
Anthony Li	05462	U3		1/1/00	3/31/00			30			30			30
Edna Neff	05460	C1		1/1/00	3/31/00	0	0	0	0	0	0	80	80	80
Edna Neff	05460	U3		1/1/00	3/31/00			40			40			40
Anna Cristina Reyes	05458	C1		1/1/00	3/31/00	0	0	0	0	0	0	70	70	70
Anna Cristina Reyes	05458	U3		1/1/00	3/31/00			0			0			70
Valerie Wright	05461	C1		1/1/00	3/31/00	0	0	0	0	0	0	80	80	80
Valerie Wright	05461	U3		1/1/00	3/31/00			0			0			0

Goddard Space Flight Center

NRC Form 3 Equivalent Reports

United States University

Occupational Exposure Record

Series: KLM	***Account Number:*** 032151	***Badge Number:*** 05099

Name: **Edgar Howell**	***SSN:*** 000-00-0230	***Sex:*** M	***E-Mail:*** Edgar.Howell@college.edu

Period Ending: *3/31/00*	***Date of Birth:***	***Address:*** 123 Edgar Drive Atlanta GA, 30324

INTAKES

Radionuclide	Class	Mode	Intake in μCi

Doses (in REM)

Deep Dose Equivalent	(DDE) =	0.010
Eye Dose Equivalent to the Lens of the eye	(LDE) =	0.010
Shallow Dose Equivalent, Whole Body	(SDE-WB) =	0.010
Shallow Dose Equivalent, Max Extremity	(SDE-ME) =	0.000
Committed Effective Dose Equivalent	(CEDE) =	0.292
Committed Dose Equivalent, Maximally Exposed Organ	(CDE) =	8.333
Total Effective Dose Equivalent	(TEDE) =	0.302
Total Organ Dose Equivalent, Max Organ	(TODE) =	8.343

COMMENTS:

Permanent Dose To Date (in REM)

DDE =	0.430	SDE-WB =	0.430
LDE =	0.430	SDE-ME =	0.260
TEDE =	0.722		

This form is for use in place of certain reports required by NRC licensees, OSHA and State regulations. It reflects data provided to or by your account and contains information for NRC Form-5 and other equivalent forms.

Signature - Licensee: ______________ **Date:** ________

Goddard Space Flight Center

RS Solutions Database

Goddard Space Flight Center

Inventory Lists by Authorized User

6/19/00

Active Radioactive Materials Inventory

AU: Storage, Interim

Source Number	Isotope	Half Life (Days)	Assay Date	Physical Form	Description	Initial Activity (mCi)	Activity Used (mCi)	Activity Left (mCi)	Current Activity (mCi)	Storage Location
078-001-00	Cf-249	1.28E+05	1/16/70	Sealed		1.60E-02	0.00E+00	1.60E-02	1.51E-02	Carnegie G-112
078-003-00	Cs-137	1.10E+04	11/4/65	Sealed	Metal pellet	1.00E+03	0.00E+00	1.00E+03	4.51E+02	Carnegie Vault
078-005-00	H-3	4.49E+03	5/31/72	Solid	Neutron Generator Target	4.00E+03	0.00E+00	4.00E+03	8.21E+02	Carnegie G-112
078-006-00	Pu-239	8.81E+06	1/25/71	Liquid		1.14E-03	0.00E+00	1.14E-03	1.14E-03	Carnegie Vault
078-007-00	Np-237	7.82E+08	2/26/65	Sealed		3.53E-01	0.00E+00	3.53E-01	3.53E-01	Carnegie Vault
078-008-00	Pu-239	8.81E+06	2/26/65	Sealed	5 gm	3.07E+02	0.00E+00	3.07E+02	3.07E+02	Carnegie Vault
078-009-00	Ra-226	5.84E+05	11/5/71	Sealed	Inside guage	2.00E-02	0.00E+00	2.00E-02	1.98E-02	Carnegie G-112
078-010-00	Am-241	1.58E+05	11/1/71	Sealed		1.00E+02	0.00E+00	1.00E+02	9.55E+01	Carnegie Vault
078-011-00	U-Depl	1.63E+12	6/8/88	Solid	U-DEPL - (13 lbs)	2.00E-03	0.00E+00	2.00E-03	2.00E-03	Carnegie Vault
078-012-00	Pu-239	8.81E+06	4/23/64	Sealed	7.54 gm	4.62E+02	0.00E+00	4.62E+02	4.62E+02	Carnegie Vault
078-013-00	H-3	4.49E+03	9/11/90	Liquid		5.00E+02	0.00E+00	5.00E+02	2.88E+02	Carnegie G-112
078-014-00	H-3	4.49E+03	9/11/90	Liquid		2.50E+02	0.00E+00	2.50E+02	1.44E+02	Carnegie G-112
078-015-00	Am-241	1.58E+05	5/3/73	Sealed		1.00E+01	0.00E+00	1.00E+01	9.57E+00	Carnegie Vault

Signature: ______________________________ Date: ____________________

NOTE to the Authorized User:

Please check the accuracy of this quarterly inventory report and make any necessary changes. Sign and date all forms.

Goddard Space Flight Center

Authorized Limits

RAM Inventory Summary

Shaefer, Nolan

Isotope	*Physical Form*	*Current Activity (mCi)*	*Authorized Limits (mCi)*	*Δ (mCi)*
Cf-252	Sealed	1.97E+01	7.00E+01	5.03E+01
H-3	Sealed	7.59E+03	2.50E+04	1.74E+04
U-235	Sealed	5.32E-02	6.30E-02	9.84E-03
U-Nat	Sealed	1.73E+03	1.73E+03	7.21E-06

Inventory by Source Type

Goddard Space Flight Center

RADIOISOTOPE SOURCE INVENTORY **6/19/00**

Authorized User	Source Number	Isotope	Physical Form	Description	Total Act. mCi	Amount Used mCi	Act. Today mCi
Doyle , Dwayne							
	060-001-00	Co-60	Sealed		1.61E+06	0.00E+00	4.22E+04
	060-002-00	Co-60	Sealed		9.95E+07	0.00E+00	2.87E+06
	060-003-00	Co-60	Sealed		7.35E+07	0.00E+00	6.56E+06
	060-004-00	Co-60	Sealed	N/A	3.57E+08	0.00E+00	5.71E+07
	060-005-00	Co-60	Sealed	N/A	2.93E+08	0.00E+00	4.69E+07
						Co-60 Total (mCi):	**1.13E+08**
	060-009-00	Pu-239	Sealed	PuBe (15.96 g)	9.91E+02	0.00E+00	9.90E+02
	060-010-00	Pu-239	Sealed	PuBe (15.96 g)	9.91E+02	0.00E+00	9.90E+02
	060-011-00	Pu-239	Sealed	PuBe (15.99 g)	9.93E+02	0.00E+00	9.92E+02
	060-012-00	Pu-239	Sealed	PuBe (15.99 g)	9.93E+02	0.00E+00	9.92E+02
	060-013-00	Pu-239	Sealed	PuBe (16.0 g)	9.94E+02	0.00E+00	9.93E+02
						Pu-239 Total (mCi):	**4.96E+03**
	060-008-00	U-Nat	Sealed	2495 kg (1382 slugs)	1.72E+03	0.00E+00	1.72E+03
						U-Nat Total (mCi):	**1.72E+03**

Leak Test Reports

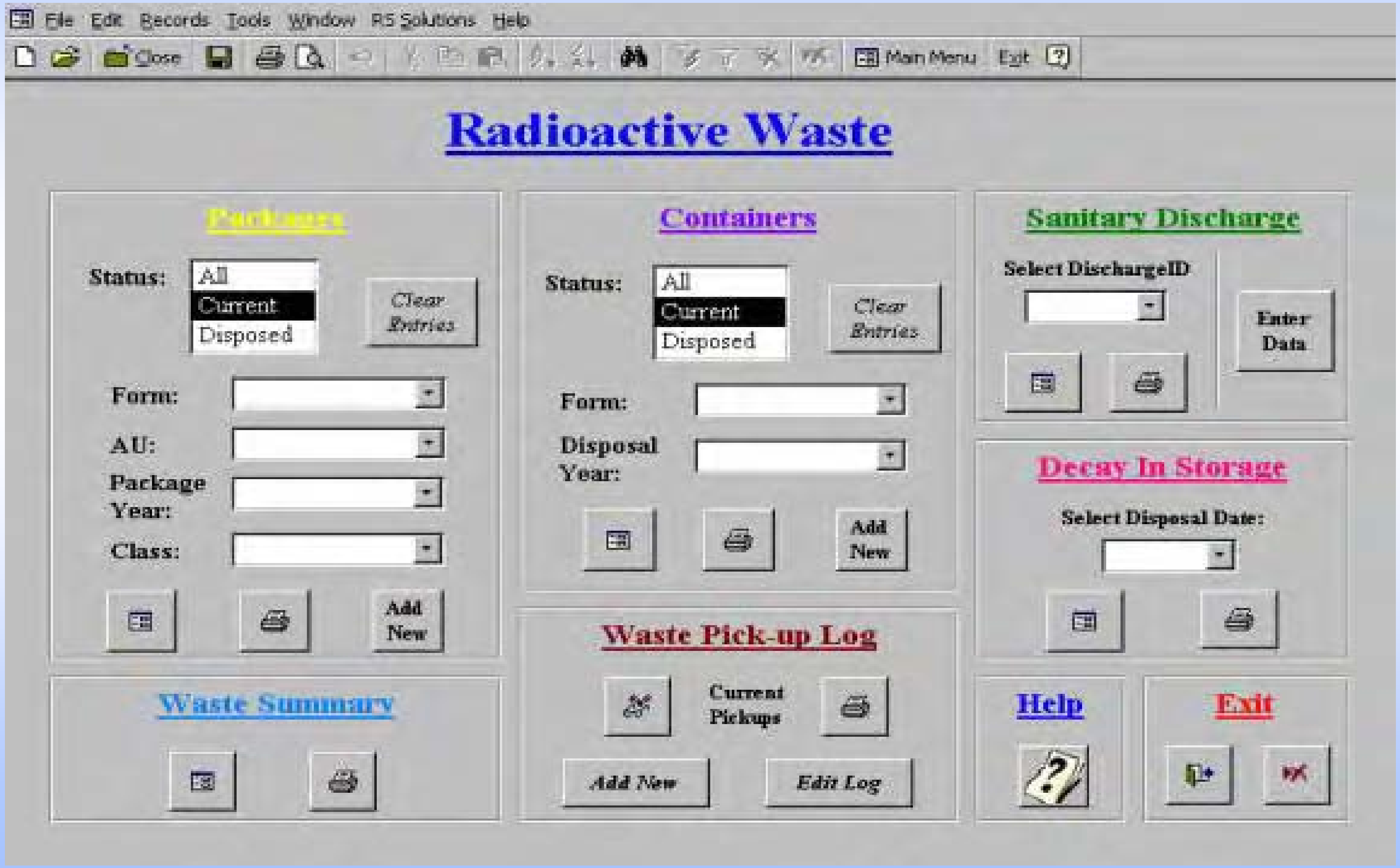
Goddard Space Flight Center

Alpha LEAK TEST Inventory **6/19/00**

Sample	Source Number	Isotope	Half Life (Days)	Assay Date	Physical Form	Description	Total Act. (mCi)	Act. Today (mCi)	Building	Storage Room	Authorized User
1	004-018-00	Ra-226	5.84E+05	8/1/77	Sealed		10	9.90E+00	Carnegie	Vault	Becker
2	012-008-00	Am-241	1.58E+05	12/5/75	Sealed		0.0131	1.26E-02	Daniel	B-81	Cox
3	018-026-00	Pu-239	8.81E+06	9/28/62	Sealed		5000	4.99E+03	Carnegie	Vault	Gray
4	040-001-00	Ra-226	5.84E+05	10/5/60	Sealed	Calibration Source	1	9.83E-01	Carnegie	Vault	Schultz
5	040-003-00	Cf-252	9.64E+02	10/4/82	Sealed	N/A	1.07	1.02E-02	Carnegie	Vault	Schultz
6	040-004-00	Cf-252	9.64E+02	12/15/82	Sealed	N/A	5.36	5.39E-02	Carnegie	Vault	Schultz
7	040-005-00	Cf-252	9.64E+02	12/15/82	Sealed	N/A	5.36	5.39E-02	Carnegie	Vault	Schultz
8	041-001-00	Cf-252	9.64E+02	8/25/95	Sealed	Cf2O3	70	1.97E+01	Carnegie	Mezzanine	Shaefer
9	041-008-00	U-235	2.57E+11	10/23/63	Sealed	17 envelopes; 22 g	0.0462	4.62E-02	Carnegie	Vault	Shaefer
10	041-009-00	U-Nat	1.62E+12	10/1/73	Sealed	1301 NU-plugs(2500.93Kg)	1728.3	1.73E+03	Carnegie	RCZ	Shaefer
11	043-002-00	Am-241	1.58E+05	7/1/89	Sealed		10	9.83E+00	Neely	Bldg. 3	Smith
12	043-003-00	Cm-244	6.61E+03	7/1/89	Sealed		30	1.97E+01	Neely	Bldg. 3	Smith
13	056-002-00	Am-241	1.58E+05	4/8/87	Sealed	Am-Be	50	4.90E+01	Carnegie	G-112	Wiggins
14	060-008-00	U-Nat	1.62E+12	9/1/61	Sealed	2495 kg (1382 slugs)	1724.1	1.72E+03	Carnegie	156	Doyle
15	060-009-00	Pu-239	8.81E+06	9/1/61	Sealed	PuBe (15.96 g)	991	9.90E+02	Carnegie	Vault	Doyle
16	060-010-00	Pu-239	8.81E+06	9/1/61	Sealed	PuBe (15.96 g)	991	9.90E+02	Carnegie	Vault	Doyle
17	060-011-00	Pu-239	8.81E+06	9/1/61	Sealed	PuBe (15.99 g)	993	9.92E+02	Carnegie	Vault	Doyle
18	060-012-00	Pu-239	8.81E+06	9/1/61	Sealed	PuBe (15.99 g)	993	9.92E+02	Carnegie	Vault	Doyle
19	060-013-00	Pu-239	8.81E+06	9/1/61	Sealed	PuBe (16.0 g)	994	9.93E+02	Carnegie	Vault	Doyle
20	078-001-00	Cf-249	1.28E+05	1/16/70	Sealed		0.016	1.51E-02	Carnegie	G-112	Storage
21	078-007-00	Np-237	7.82E+08	2/26/65	Sealed		0.353	3.53E-01	Carnegie	Vault	Storage
22	078-008-00	Pu-239	8.81E+06	2/26/65	Sealed	5 gm	307	3.07E+02	Carnegie	Vault	Storage
23	078-009-00	Ra-226	5.84E+05	11/5/71	Sealed	Inside guage	0.02	1.98E-02	Carnegie	G-112	Storage

Goddard Space Flight Center

RS Solutions Database



Rad Waste Package Logs

Goddard Space Flight Center

Radioactive Waste Package Log

Package ID: W1998-006-05 **Date:** 6/30/98
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
S-35	006-158-00	0.02

Package ID: W1999-006-06 **Date:** 8/ 4/99
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
S-35	006-163-00	0.02

Package ID: W1998-006-06 **Date:** 6/30/98
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
S-35	006-157-00	0.01

Package ID: W1999-006-07 **Date:** 8/ 4/99
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
S-35	006-165-00	0.01

Package ID: W1999-006-04 **Date:** 8/ 4/99
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
H-3	006-149-00	0.8

Package ID: W1999-006-08 **Date:** 8/ 4/99
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
S-35	006-163-00	0.02
S-35	006-164-00	0.01

Package ID: W1999-006-05 **Date:** 8/ 4/99
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: A1998-07 **Date:**

Isotope	Source Number	Activity (mCi)
Ca-45		0.04

Package ID: W1999-006-09 **Date:** 8/ 4/99
AU: Bradley, Jung **Form:** Liquid
Disposal Cont. ID: DIS **Date:**

Isotope	Source Number	Activity (mCi)
P-32		0.08

Rad Waste Container Reports

Goddard Space Flight Center

Rad Waste Shipping Containers

Container ID: A199604 **Volume:** 30 gallons (3.9 cubic feet)

Shipment Date 4/1/99 **Form:** Aqueous

Contamination Survey Done: Yes **Dose Rate Survey (mSv/hr):** 0.0005 **Transport Index:** N/A

Package ID	Date	Authorized User	Package ID	Date	Authorized User
W1996-004-02	10/23/96	Becker, Bernd	W1996-014-05	8/29/96	Ellis, Athanassios
W1996-020-07	5/21/96	Harris, Cheng	W1996-039-03	10/16/96	Rupp, Michael
W1996-039-04	10/16/96	Rupp, Michael	W1996-039-05	10/16/96	Rupp, Michael
W1996-078-01	6/19/96	Storage, Interim	W1996-078-02	6/21/96	Storage, Interim
W1996-078-03	10/31/96	Storage, Interim	W1997-006-03	7/10/97	Bradley, Jung
W1997-006-09	9/11/97	Bradley, Jung	W1997-006-10	9/11/97	Bradley, Jung
W1997-008-01	1/30/97	Caldwell, Richard	W1997-008-02	1/30/97	Caldwell, Richard
W1997-008-03	1/30/97	Caldwell, Richard	W1997-008-04	1/30/97	Caldwell, Richard
W1997-008-05	1/30/97	Caldwell, Richard	W1997-008-06	1/30/97	Caldwell, Richard
W1997-008-07	1/30/97	Caldwell, Richard	W1997-008-08	1/30/97	Caldwell, Richard
W1997-008-12	8/13/97	Caldwell, Richard	W1997-008-14	11/12/97	Caldwell, Richard
W1997-014-01	5/1/97	Ellis, Athanassios	W1997-019-01	7/16/97	Haich, Robert
W1997-050-01	7/30/97	Valentin, Robert	W1998-006-01	2/5/98	Bradley, Jung
W1998-006-02	2/5/98	Bradley, Jung	W1998-006-03	2/5/98	Bradley, Jung
W1998-014-02	4/16/98	Ellis, Athanassios	W1998-050-03	3/6/98	Valentin, Robert
W1998-050-04	3/6/98	Valentin, Robert	W1998-050-06	5/20/98	Valentin, Robert
W1998-050-07	5/20/98	Valentin, Robert			

Isotope	Activity (mCi)	Activity (MBq)
C-14	8.53E-01	3.16E+01
Co-60	1.00E-04	3.70E-03
Cr-51	6.42E+00	2.38E+02
Eu-154	2.39E-04	8.84E-03
Eu-155	7.70E-05	2.85E-03
H-3	5.21E+00	1.93E+02
I-125	2.20E-02	8.14E-01
Kr-85	3.00E-02	1.11E+00
Ni-63	1.00E-01	3.70E+00

Goddard Space Flight Center

Decay In Storage Reports

Radioactive Waste - Decay In Storage

Form: Liquid

DIS Date	Receipt Date	PackageID	Isotope	Initial Activity (mCi)	Current Activity (mCi)	DIS DisposalDate
9/24/99	5/5/99	W1999-990-01	P-32	3.60E+00	7.57E-09	
9/24/99	5/5/99	W1999-990-02	P-32	2.25E+00	4.73E-09	
10/29/99	6/9/99	W1999-990-19	P-32	2.55E-01	2.93E-09	
11/14/99	6/25/99	W1999-990-20	P-32	2.10E-01	5.24E-09	
12/4/99	7/15/99	W1999-990-04	P-32	9.50E-01	6.25E-08	
12/11/99	7/22/99	W1999-990-23	P-32	2.75E-01	2.54E-08	
12/17/99	7/28/99	W1999-990-01	P-32	3.00E-01	3.71E-08	
12/24/99	8/4/99	W1999-990-09	P-32	8.00E-02	1.39E-08	
12/24/99	8/4/99	W1999-990-10	P-32	9.00E-02	1.56E-08	
12/31/99	8/11/99	W1999-990-30	P-32	3.85E-01	9.38E-08	
2/4/00	9/15/99	W1999-990-36	P-32	2.60E-01	3.46E-07	
2/6/00	5/5/99	W1999-990-04	Cr-51	2.67E+00	8.93E-05	
2/25/00	10/6/99	W1999-990-39	P-32	2.20E-01	8.10E-07	
2/28/00	10/9/99	W1999-990-02	P-32	1.89E+00	8.05E-06	
4/17/00	7/15/99	W1999-990-05	Cr-51	3.34E+00	6.59E-04	

Goddard Space Flight Center

Rad Waste Pickup Log

RadWaste Pickup Log

AU Name: *Anderson, Roger*

Lab	*Date Pick-up requested*	*Scheduled Pick-up*	*Solid Containers*	*Liquid Containers*	*LSC Vials*	*Comment*
Commander 213	4/25/00	5/10/00	1	0	0	

AU Name: *Becker, Bernd*

Lab	*Date Pick-up requested*	*Scheduled Pick-up*	*Solid Containers*	*Liquid Containers*	*LSC Vials*	*Comment*
GCATT G-1,2	4/28/00	5/10/00	2	0	1	

AU Name: *Schultz, Edgar*

Lab	*Date Pick-up requested*	*Scheduled Pick-up*	*Solid Containers*	*Liquid Containers*	*LSC Vials*	*Comment*
Carnegie 147	4/27/00	5/10/00	2	1	1	

Sewer Discharge Reports

Goddard Space Flight Center

Sanitary Discharge

DischargeID: 2000-01

$$\text{Sum of Fractions} = \sum_{i}^{n} \frac{(\text{Isotope Concentration})_i \ \mu Ci/ml}{(\text{Release Limit})_i \ \mu Ci/ml} \qquad \textit{where} : n = \textit{number of radionuclides}$$

***Sum of Fractions* = 0.543**

Note: Sum of Fractions must be less than one (1) to authorize release. Calculations must be reviewed before allowing release to the sewer.

Note: Total Yearly Discharge: H-3 < 5 Ci , C-14 < 1 Ci
All other Isotopes < 1 Ci

Total Daily Discharge in μCi

C-14	*H-3*	*All Other Isotopes*
0.10	5.77	0.04

Total Yearly Discharge in μCi

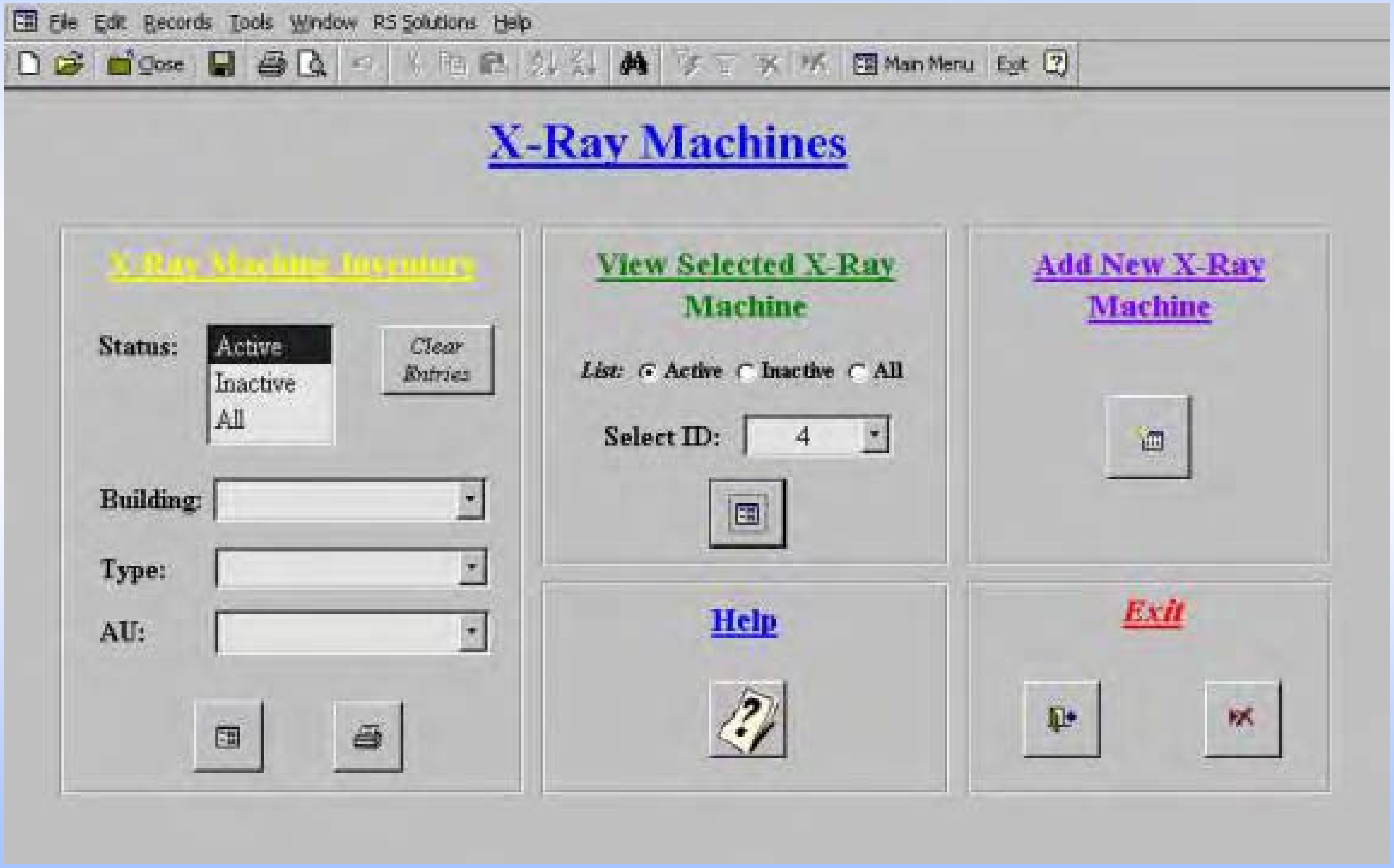
Year	*C-14*	*H-3*	*All Other Isotopes*
2000	0.11	8.61	0.10

Date: *3 /8 /00*

Isotopes	*Concentration μCi/ml*	*Volume Discharged (gal)*	*Total Discharge μCi*
C-14	8.50E-07	2.0	0.01
C-14	8.50E-06	3.0	0.10
H-3	1.00E-05	1.5	0.06
H-3	7.55E-04	2.0	5.72
I-125	8.50E-06	1.0	0.03
P-32	9.00E-07	1.0	0.00

Goddard Space Flight Center

RS Solutions Database



Goddard Space Flight Center

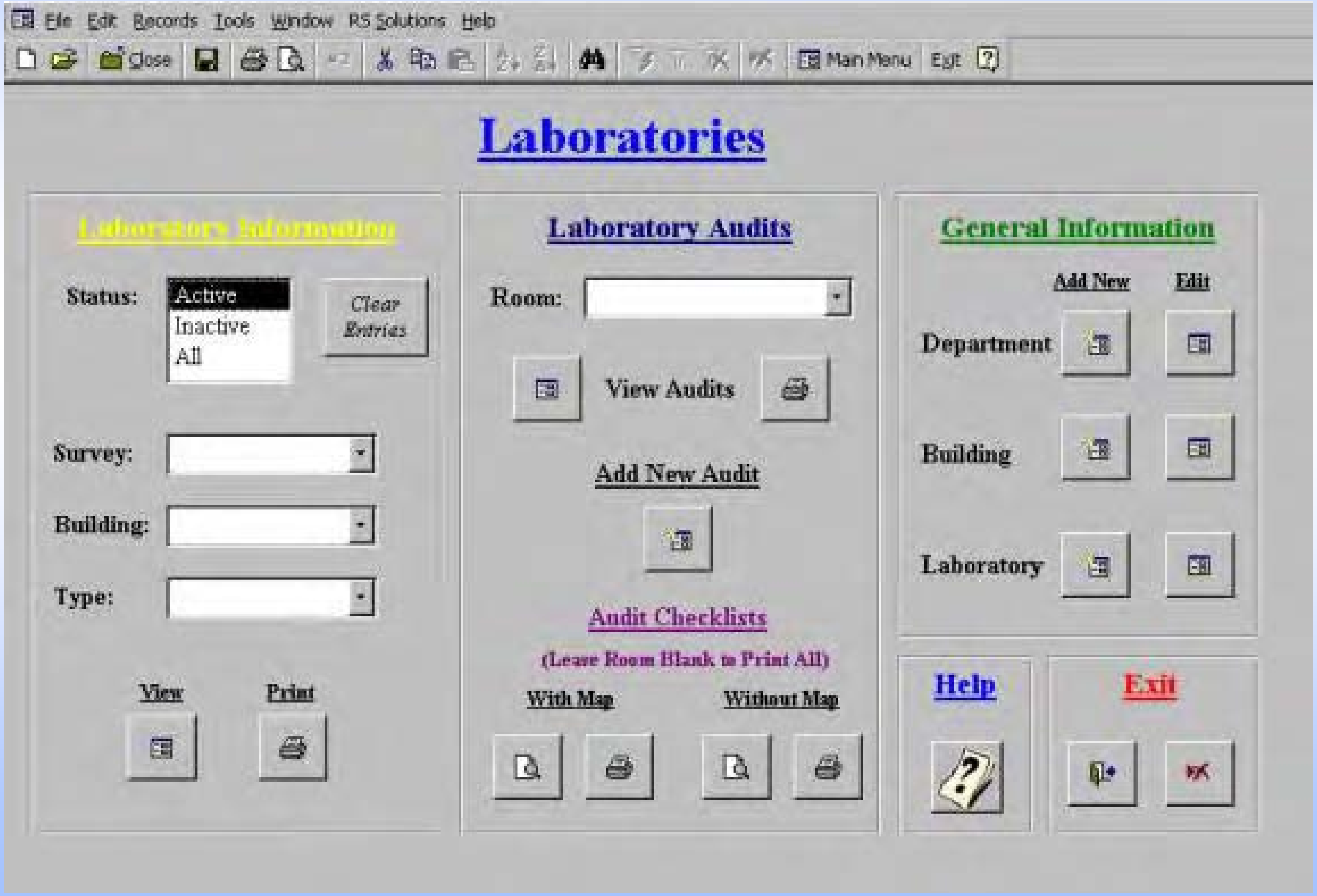
X-Ray Device Inventory

X-Ray Machines

ID #	AU	Type	Make	Model	S/N	Location	Status	Date
12	Lathem, Yolande	EM	Hitachi		123467	Burge 142	Active	9/20/99
24	Ford, Stuart	XRD	Philips	PW1800	123479	Burge 153	Active	9/27/99
42	Lathem, Yolande	EM	Hitachi	HF-2000	123498	Burge 144	Active	9/20/99
43	Lathem, Yolande	EM	JEOL	4000EX	123499	Burge 147	Active	9/20/99
44	Ford, Stuart	XRD	Bede Scientific	QC2A	123500	Burge 153	Active	9/27/99
51	Lathem, Yolande	EM	JEOL	100C	123507	Burge 132A	Active	9/20/99

Goddard Space Flight Center

RS Solutions Database



Goddard Space Flight Center

Lab Location Lists

Campus Laboratories - Active

Building: Armstrong

Room	Status	Lab Type	Phone #	Authorized User(s)		
1231	Active	Neighborhood	(404) 555-0680	Fu-chung, F.		
1405	Active	Neighborhood	(404) 555-3240	Ellis, A.		
1420	Active	Enclosed	(404) 555-0509	Wasowski, Y	Downs, C.	Hinton, M.
				Johansson, A.	Cinader, H.	Abernathy, J.
				Anderson, R.	Bradley, J.	Ellis, A.
				Harris, C.		
2205A	Active	Enclosed	(404) 555-1323	Bradley, J.		
2205B	Active	Enclosed	(404) 555-1312	Elliot, N.	Cinader, H.	Gaines, J.
2334	Active	Enclosed	() 555-	Elliot, N.		
2402	Active	Enclosed	(404) 555-0509	Hinton, M.		
2402A	Active	Neighborhood	(404) 555-0509	Hinton, M.		
2403A	Active	Enclosed	(404) 555-0509	Valentin, R.	Johansson, A.	
3128	Active	Neighborhood	() 555-	Downs, C.		
3130	Active	Neighborhood	() 555-	Downs, C.		
3132	Active	Neighborhood	() 555-	Abernathy, J.		

Building: Burge

Room	Status	Lab Type	Phone #	Authorized User(s)
363	Active	Enclosed	() 555-	Garner, B.

Building: Carnegie

Room	Status	Lab Type	Phone #	Authorized User(s)		
G-112	Active	Enclosed	() 555-	Wiggins, J.	Storage, I.	Adams, M.
				Carr, M.	Dickson, C.	Gray, R.
RadVan	Active	Enclosed	() 555-	Gray, R.		

Building: Daniel

Room	Status	Lab Type	Phone #	Authorized User(s)	
1-33N	Active	Enclosed	(404) 555-4063	Ravenel, G.	
1-44	Active	Enclosed	(404) 555-4063	Ravenel, G.	
B-81	Active	Enclosed	() 555-	Cox, R.	Glass, L.

Lab Audit Checklists

Goddard Space Flight Center

Laboratory Audit Checklist

Description

Location: Armstrong 3132 Lab Type: Neighborhood

AU: Abernathy, James

Authorized Isotopes C-14 H-3

Radiation Workers: (Must have attended Radiation Safety Training Lecture)

Kahn, Chih-Min Pattanaik, James

Survey Meter: Eberline E-120 S/N: A664X

Calibration Due Date: 4/28/01 Battery Check: OK / Low / N/A

Audit Items

Proper Postings (Notice to Employees, Doors, Fridges, etc.):	Yes / No	Personnel Dosimeters Worn and Stored Appropriately:	Yes / No / NA
Materials Labelled Properly:	Yes / No	No Food or Drink in Room	Yes / No
Surveys Performed and Documented Appropriately:	Yes / No / NA	Appropriate Waste Storage:	Yes / No / N/A
Appropriate Security:	Yes / No	Appropriate Shielding:	Yes / No / N/A

Comments / Violations

Level

Previous Violations (Past Year)

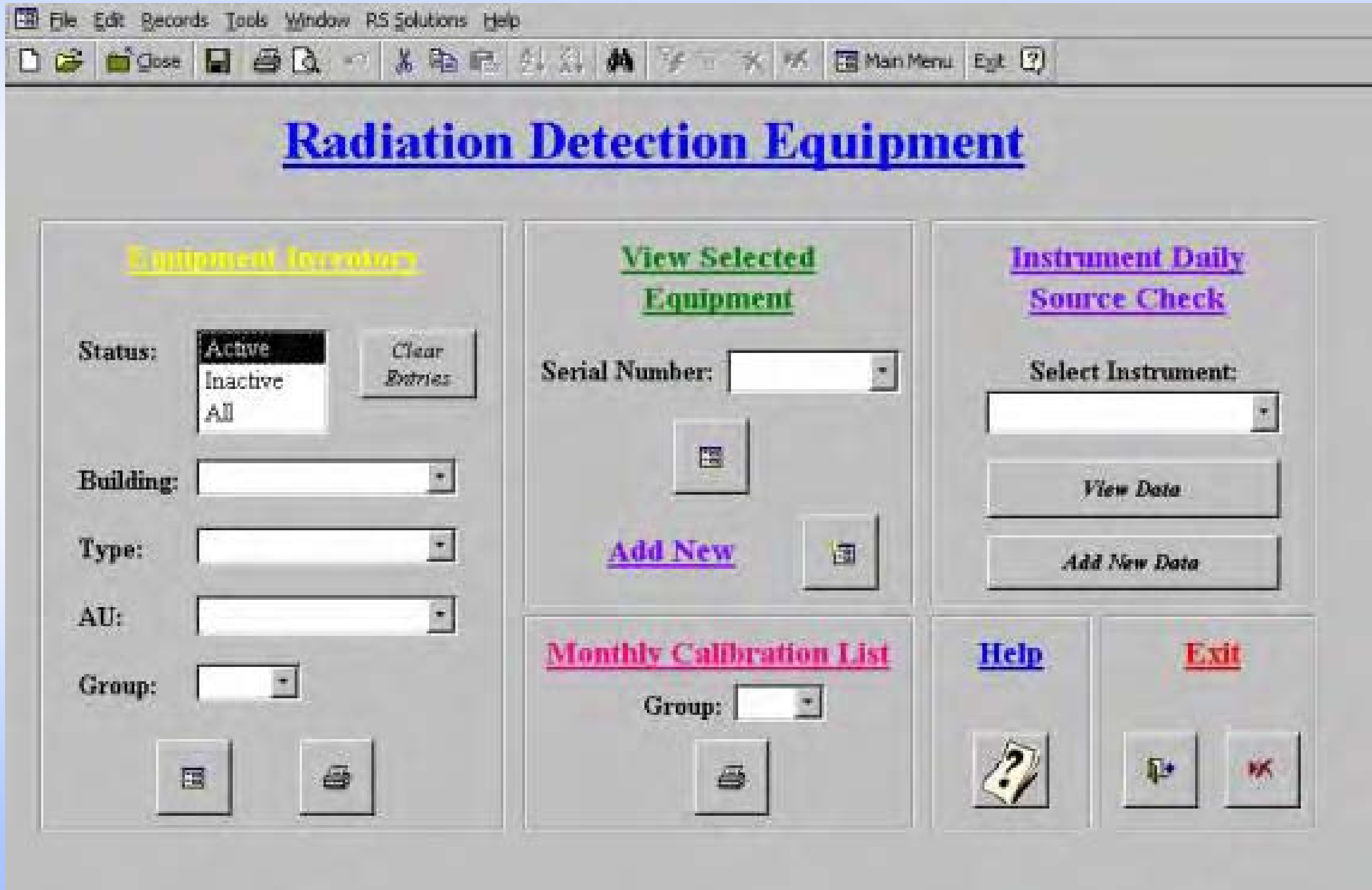
Date	Level	Description
4/1/00	1	Abernathy, James - Lab personnel were found eating and drinking in the laboratory

Performed By: Date:

Reviewed By: Date:

Goddard Space
Flight Center

RS Solutions Database



Equipment Inventory

Radiation Detection Equipment

Status	Cal. Due	Type	Instrument	Serial #	Authorized User	Location	Last Cal.
Active	3/8/01	GM	Eberline E-120	42481	Ghali, Agaram	Folk 4340	3/31/00
Active	3/8/01	GM	Eberline RM-14	185	Gray, Rod	Carnegie 147	3/8/00
Active	3/10/01	GM	Dosimeter 3007A	1047	Ravenel, Gary	Daniel 1-44	3/31/00
Active	3/30/01	GM	Eberline PRM-6	9533-226	Henderson, Chris	Carnegie G-122	3/31/00
Active	3/30/01	GM	Ludlum 2	107187	Gray, Rod	Carnegie 147	3/30/00

Goddard Space Flight Center

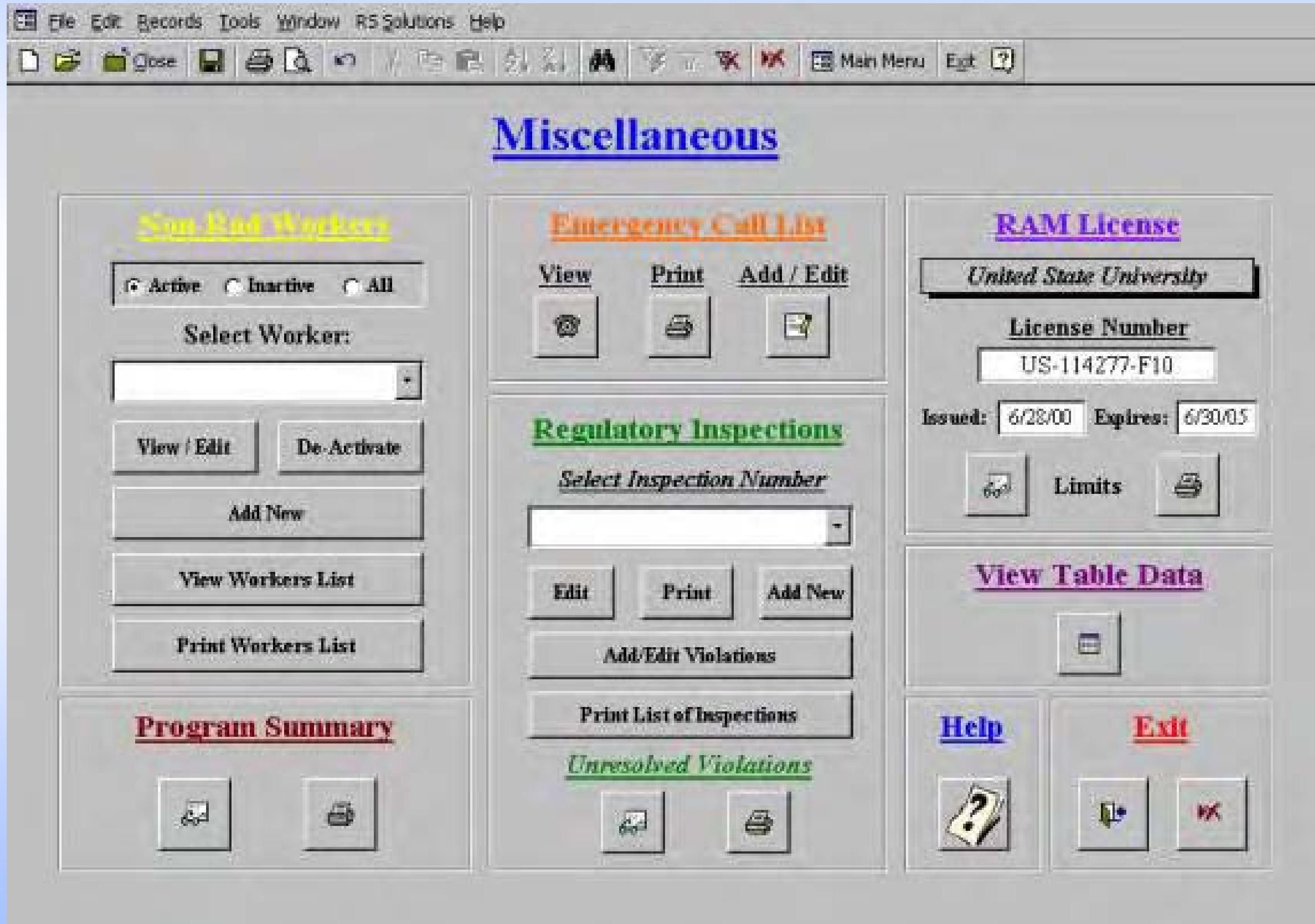
Calibration Schedules

Equipment Calibration Work Order — Group 4

Next Cal. Due	Last Cal.	Instrument	Manufacturer	Model	Serial Number	Status
4/15/01	5/8/00	GM	Victoreen	493	1604-A	Active
4/28/01	5/1/00	GM	Eberline	E-120	A664X	Active
4/30/01	5/1/00	GM	Ludlum	2	2008	Active
4/30/01	5/2/00	GM	Ludlum	3	9505-012	Active
4/9/99	4/9/98	Alpha/Beta	Eberline	SHP-380AB	1090198	Out of Service
4/20/99	4/20/98	GM	Eberline	SHP-360	2737	Out of Service

Goddard Space Flight Center

RS Solutions Database



Goddard Space Flight Center

NRC Inspections

Regulatory Inspections

Inspection Number	*Inspection Date*	*Comments*
2000-01	2/11/00	First inspection of the year. Office was sited for two violations

List of Violations

Violation Number	*Violation Level*	*Comments*	*Corrective Action*	*Resolved*
1	IV	Laboratory door open. Food found in trash can. Sources not properly secured	RSO Informed authorized user. Copy of letter in file. Refresher training to be given to all rad workers.	☑
2	III	Alpha Leak Test for the last quarter of year 1999 was not performed on time.	Problem in the work order system was corrected	☐

Goddard Space Flight Center

Emergency Call List

Emergency Call List

Name	PhoneNumber
Fire	(911) - x
Nuclear Regulatory Commission	(800) 888-1234 x
Police	(911) - x
Public Relations	(404) 555-1542 x3251
Assistant Radiation Safety Officer	(404) 555-1151 x
Radiation Safety Officer	(404) 555-3605 x

Goddard Space Flight Center

Program Summary

Program Summary

United States University

Employees:

Authorized Users:	68
Radiation Workers	433
Non-Rad Workers:	1

Dosimetry:

Badges:	190
Accounts:	2
Series:	18

RAM Orders:

Recd. This Year:	34
Recd. This Month:	2
Awaiting Receipt:	4

Equipment:

Detection Devices:	88
X-Ray Machines:	23

Laboratories:

Departments:	26
Laboratories:	80

Rad Waste:

Packages(Decay Storage):	47
Waste Containers on hand:	5
Containers shipped this year:	

RAM Inventory Summary

Isotope	*Physical Form*	*Current Activity (mCi)*	*Authorized Limits (mCi)*	*License Limits (mCi)*	*Δ (mCi)*
Am-241	Liquid	9.21E-02	1.00E-03	1.10E+03	1.10E+03
Am-241	Sealed	1.64E+02	1.31E-02	1.00E+04	1.00E+04
Am-241	Solid	1.52E-04	1.00E-03	1.10E+03	1.10E+03
Am-243	Liquid	5.00E-06	1.00E-05	4.00E+02	4.00E+02
Ba-133	Liquid	2.72E-02	1.00E-01	4.00E+03	4.00E+03
Ba-133	Sealed	3.97E-03	6.00E-03	4.00E+03	4.00E+03
Bi-207	Sealed	4.01E-03	1.00E-02	4.00E+03	4.00E+03
Bi-207	Solid	9.69E-03	1.00E-01	4.00E+03	4.00E+03
C-14	Liquid	1.03E+00	1.00E+00	4.00E+03	4.00E+03
C-14	Sealed	1.67E-04	1.00E-02	4.00E+03	4.00E+03
C-14	Solid	4.23E+00	1.10E+00	4.00E+03	4.00E+03
Cd-109	Sealed	1.93E+00	1.00E-02	4.00E+03	4.00E+03

Goddard Space Flight Center

Any questions?

Dan Simpson
GSFC Radiation Safety Officer
301-286-0280
Daniel.S.Simpson@nasa.gov

WFF RF Hazard Assessment Database

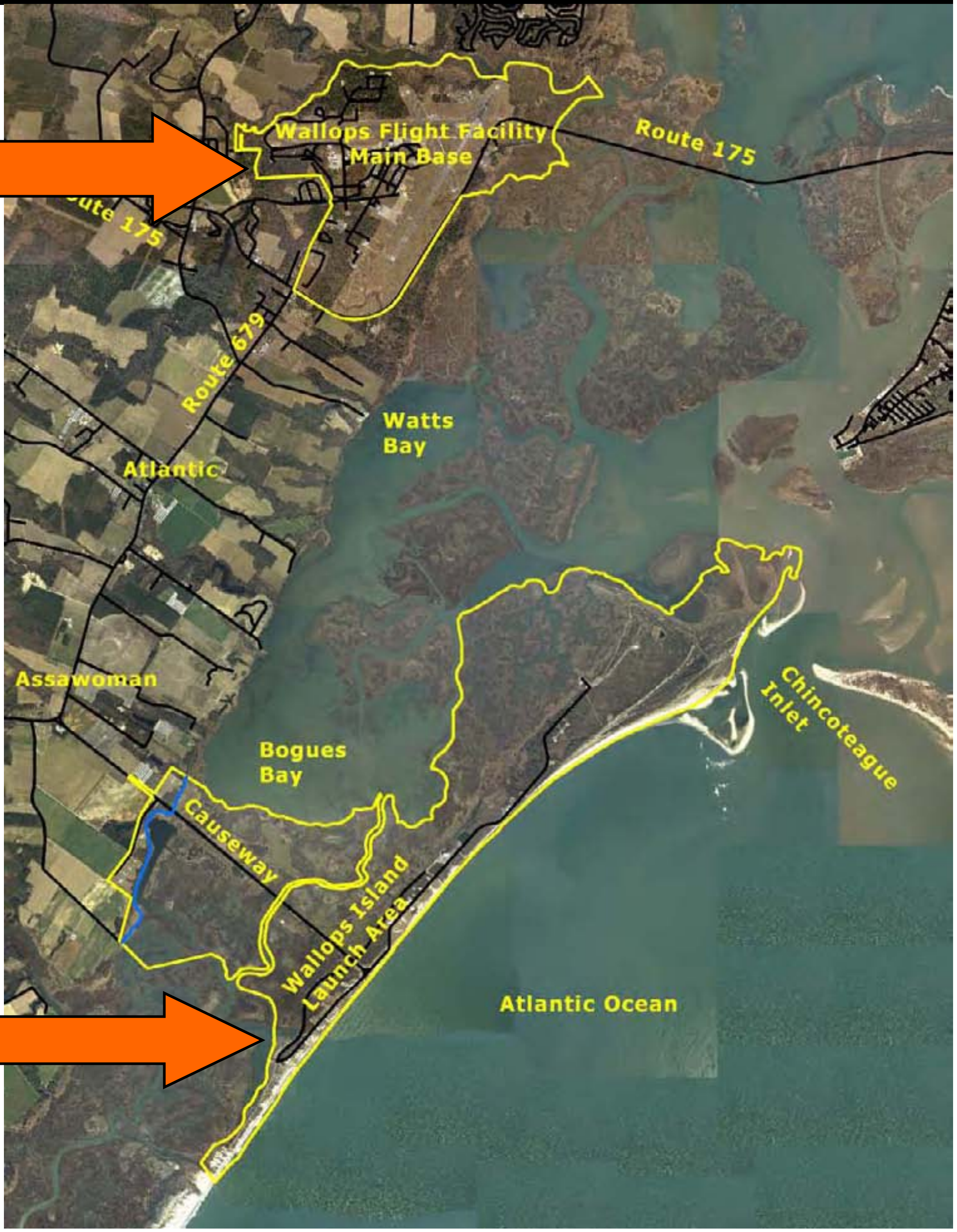
M. Bunting

Wallops Flight Facility

5/16/2008

Wallops 6000 Acre Campus

GSFC/Wallops Flight Facility



GSFC/Wallops
Flight Facility

Wallops Flight Facility

Three Major Parcels 6000 Acres

•Wallops Main Base 1900 Acres
- ***•Administrative & Technical Offices***
- ***•Tracking & Data Acquisition***
- ***•Range Control Center***
- ***•Ordnance Storage/Processing***
- ***•R&D, Processing Facilities***
- ***•Research Airport***
- ***•Navy Administration/Housing***
- ***•Coast Guard Housing***

•Wallops Island 3000 Acres
- ***•Launch Sites***
- ***•Blockhouses***
- ***•Radar***
- ***•Processing Facilities***
- ***•Dynamic Spin Balance***
- ***•Navy Operational Facilities***

•Wallops Mainland 100 Acres
- ***•Tracking & Data Acquisition***

•Marshland 1000 Acres

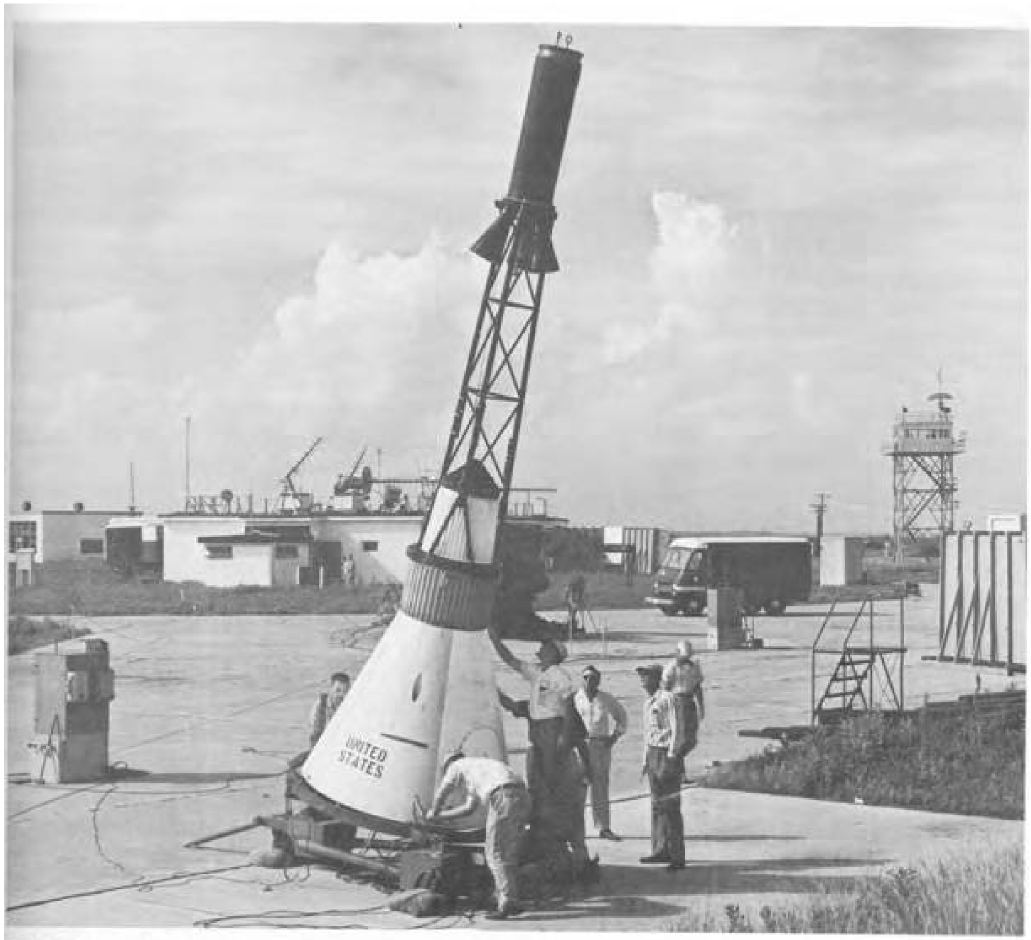
GSFC/Wallops
Flight Facility

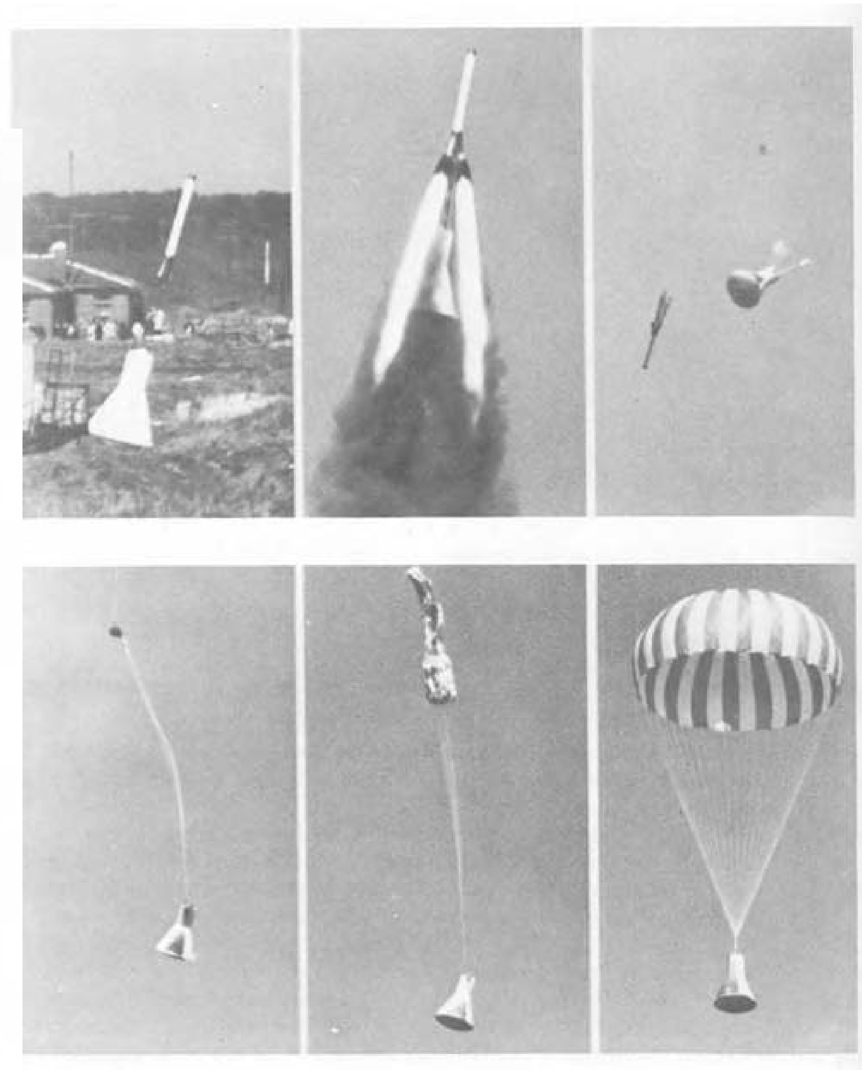
Wallops History

- ***Established by National Advisory Committee on Aeronautics in 1945 as test site for aerodynamic research***
- ***Over 16,000 launches conducted during 62 year history***
- ***Wallops mission has evolved to include:***
    - ***Flight program management***
    - ***Technology development***
    - ***Scientific research***

GSFC/Wallops Flight Facility

Wallops Demonstration of Mercury Launch Abort System

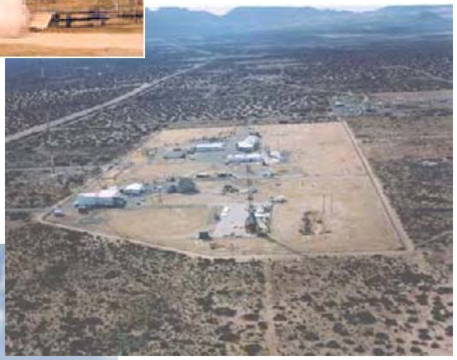




GSFC/Wallops Flight Facility

Sounding Rocket Launch Locations

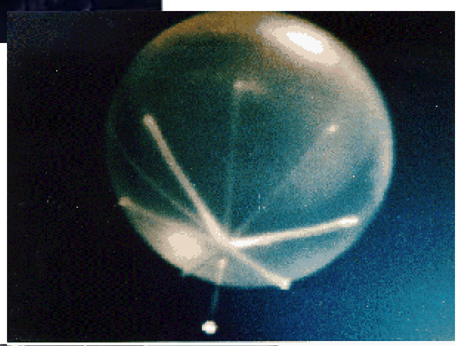
- ***Fixed Launch Sites***
  - ***Wallops Research Range***
  - ***White Sands Missile Range (NM)***
  - ***Poker Flat Research Range (AK)***
  - ***Andoya & Svalbard (Norway)***
  - ***Esrange (Kiruna, Sweden)***
  - ***Kauai***



- ***Recent Mobile Campaign Sites***
  - ***Kwajalein***
  - ***Australia***
  - ***Puerto Rico***
  - ***Brazil***
  - ***Greenland***

Balloon Program

Balloon
Inflation



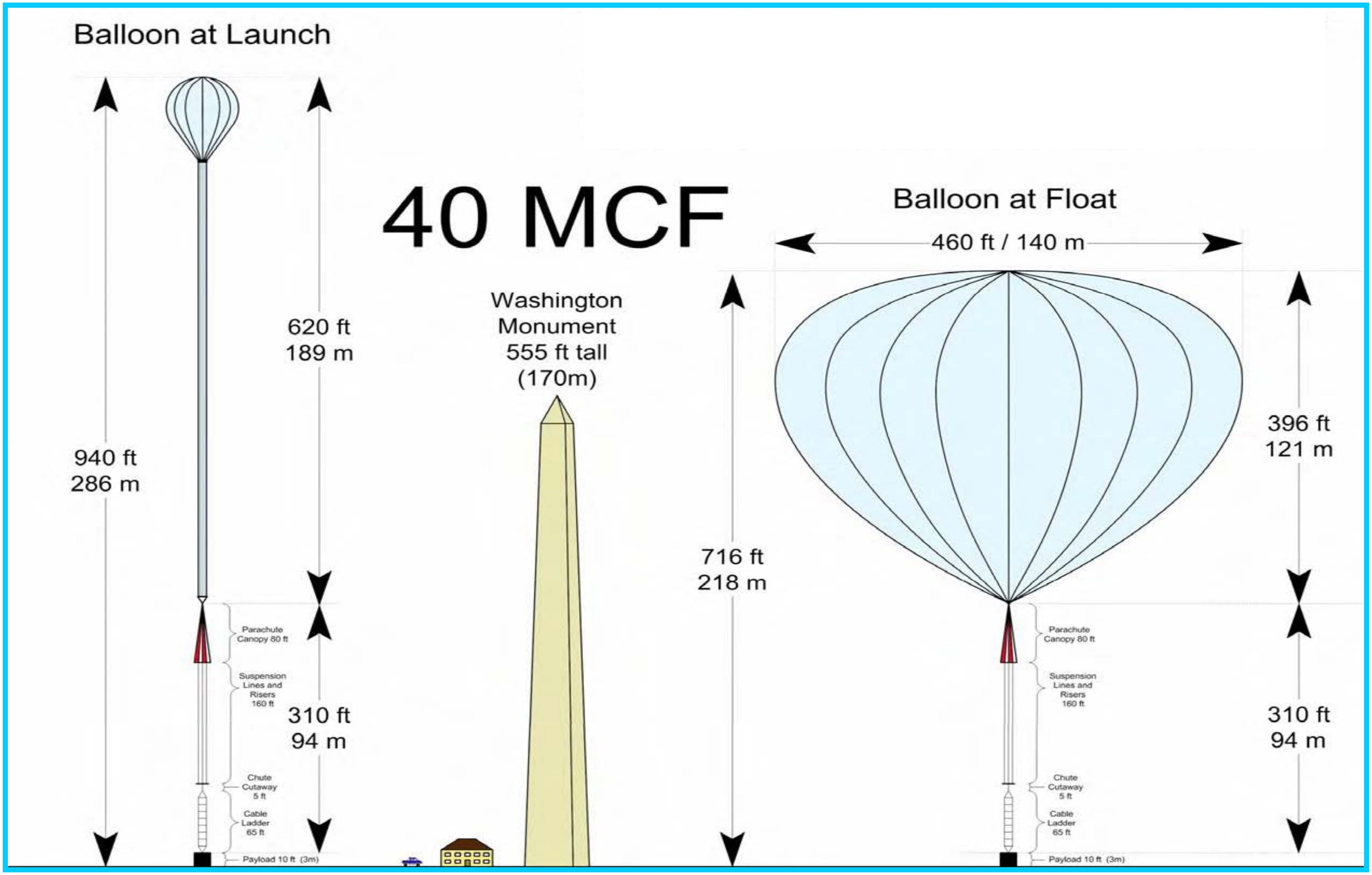
Balloon
at Float

Balloon
Payload

- ***Primary mission:***
  - ***Space Science research***
- ***15-20 missions/year***
- ***Features***
  - ***Balloon volumes up to 60M cubic ft.***
  - ***Suspended loads up to 8000 lbs.***
  - ***Float altitudes of 100K-160K feet***
  - ***Mission durations of >1 month***
- ***Worldwide mission sites***
- ***Development efforts:***
  - ***Ultra-Long Duration Balloon***
  - ***Trajectory control***
  - ***Planetary balloons***

Balloon Characteristics

GSFC/Wallops Flight Facility



Airborne Science Program

GSFC/Wallops Flight Facility

NASA P-3 (based at WFF)

NASA DC-8 (based at U of ND)

Twin Otter (contracted)

- ***Piloted aircraft & UAV "flying laboratories" supporting Earth Science research***
  - ***Heavy Lift:***
    - ***Wallops: P-3B***
    - ***U of ND: DC-8***
    - ***Pass throughs: WB57 (JSC), ER-2 (DFRC)***
  - ***Contract Aircraft: Twin Otter (others pending)***
  - ***UAVs: AAI/Aerosonde, Aurora***
- ***Research examples:***
  - ***Atmospheric Chemistry***
  - ***Climate Change***
    - ***Ice cap & beach mapping***
    - ***Ocean current & biology studies***
    - ***Coastal Zone Research***
  - ***Natural Disasters***
    - ***Hurricane studies & volcano eruptions***
- ***Aircraft activities***
  - ***Mission planning***
  - ***Aircraft operations & maintenance***
  - ***Aircraft modifications & certification***

Uninhabited Aerial Systems

GSFC/Wallops Flight Facility

Aurora GE-80

Aerosonde

Wallops UAS Runway

- ***WFF UAV Activities***
  - ***Science missions***
  - ***Operations***
  - ***Science-enabling technology development***

- ***NASA investigating UAV contribution to science. UAVs offer:***
  - ***More hazardous flight regimes***
  - ***Longer duration missions***
  - ***Potentially lower costs***

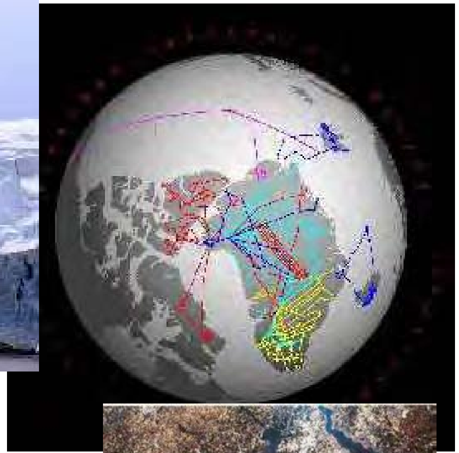
- ***AAI/Aerosonde partnership***
  - ***Demonstrate utility of small UAVs for science***
  - ***Establish procedures for science projects***
  - ***Execute science missions***

- ***Aurora Flight Sciences partnership***
  - ***UAV infrastructure upgrades***
  - ***Development & demo. of UAV-independent & science-independent data systems***

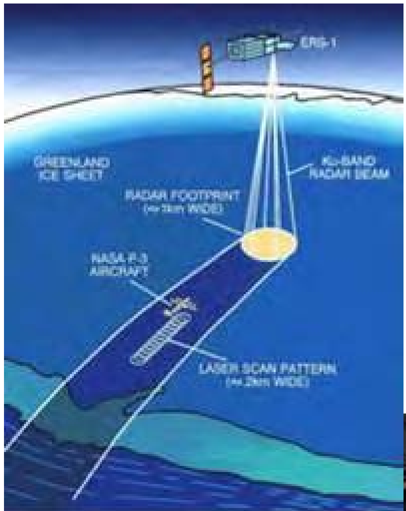
GSFC/Wallops Flight Facility

Earth Science Research

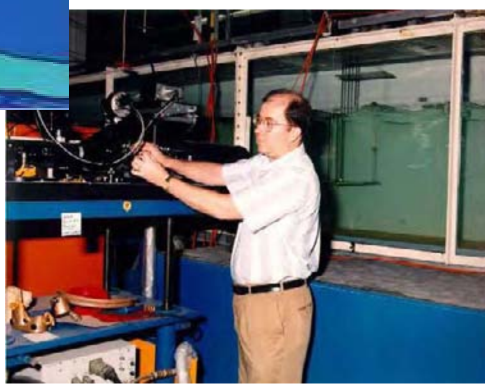
Antarctic & Greenland Ice Mapping



Coastal Zone Research



Laser & Radar Altimetry



Wallops "Wave Tank"

Research activities include:

- ***Atmospheric chemistry***
- ***Beach erosion***
- ***Arctic ice mapping***
- ***Hurricanes***
- ***Satellite Altimetry***
- ***Biological modeling***
- ***Coastal Zone Research***

Remote & in-situ instruments flown on aircraft, balloons, & rockets

Worldwide data measurements

Cal/Val instrument support

Laboratories include:

- ***Air-Sea Interaction Facility***
- ***Rain-Sea Interaction Facility***

Wallops Mission Operations

Launch Range

Mobile Range

Research Airport

Orbital Tracking

Launch Range





- ***NASA's only launch range***
  - ***Over 16,000 launches conducted since 1945***
- ***Support:***
  - ***NASA science & technology (primary)***
  - ***DoD & other gov't agencies***
  - ***Commercial industry***
- ***Full suite of support services***
  - ***Launchers***
  - ***Processing facilities & logistics***
  - ***Range safety***
  - ***Tracking & data services***
- ***Specialized focus:***
  - ***Suborbital & small orbital launch vehicles***
  - ***Experimental vehicles & payloads***
  - ***Responsive & low-cost missions***

Numerous & Diverse Launch Capabilities

MARS Pad 0B

Orbital Sciences
Pegasus

Pad 1 50K Launcher

20K ARC Rail Launcher

MARS Pad 0A

20K AML Launcher

Navy Target Launchers

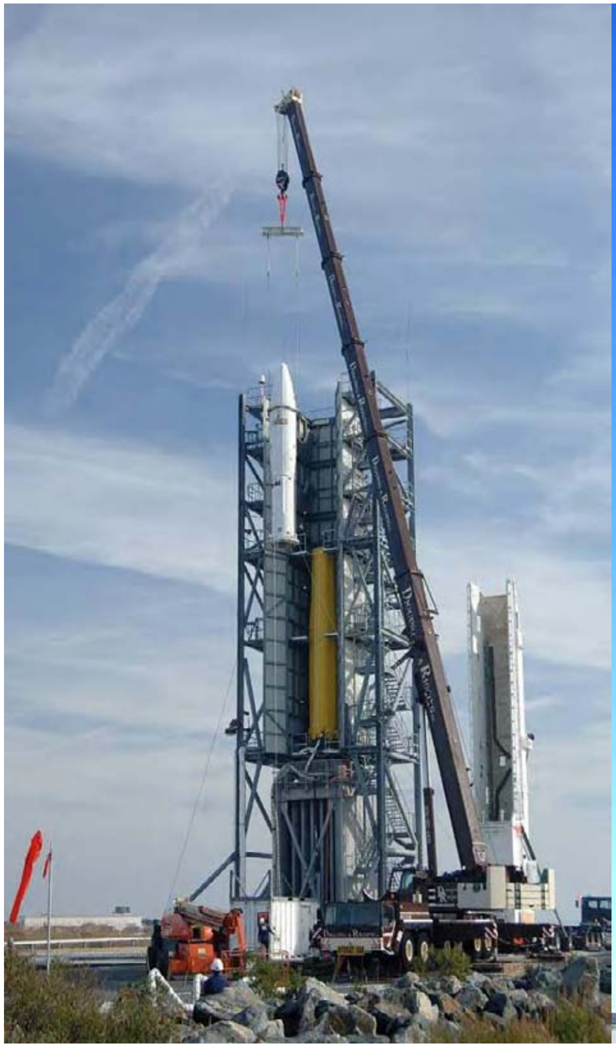
Wallops Small Sat Launch History

GSFC/Wallops
Flight Facility

- ***Worldwide:***
  - ***1 Minotaur mission (Wallops)***
  - ***20 Scout missions (Wallops)***
  - ***9 Pegasus (8 from Wallops)***
    - ***1 mobile from Canary Islands***
  - ***1 Conestoga (Wallops)***
  - ***1 Athena (mobile from Kodiak, AK)***

- ***Most recent orbital ground launch from Wallops Island:***
  - ***December 16, 2006 TacSat-2***

Minotaur at Wallops



GSFC/Wallops
Flight Facility

Wallops Tenants

Land Owner

Goddard Space Flight Center

Tenants

Navy/Surface Combat Systems Center

Naval Air Warfare Center (Patuxent River)

NOAA

U. S. Coast Guard

Mid-Atlantic Regional Spaceport

GSFC/Wallops Flight Facility

U.S. Navy at Wallops

- ***Surface Combat Systems Center***
  - ***Aegis Combat Training Center***
    - ***Cruiser & destroyer simulators***
    - ***Crew training***
    - ***System development test bed***
  - ***Ship Self-Defense Facility***
  - ***DDG(1000) engineering facility***
- ***Naval Air Warfare Center (Patuxent River)***
  - ***Target launch operations***
  - ***Aircraft development testing***

GSFC/Wallops
Flight Facility

Wallops Partnership

NOAA at Wallops

- ***Home to NOAA's Command and Data Acquisition Station***
  - ***Tenant of NASA/Wallops***
  - ***Staff of ~100 personnel***

- ***Primary mission:***
  - ***Receive data from and transmit commands to NOAA meteorological satellites.***
- ***Also provides testing and evaluation of new systems and techniques***

GSFC/Wallops Flight Facility

Wallops RF Program

- RF Hazards have been and continue to be a major concern for Personnel, the Public, and Ordinance Safety
- Our RF database was an evolution out of necessity with 30 – 40 evaluations performed annually

Hand Calculation → Spreadsheet → Database

Wallops RF Program

- *Why move from a Spreadsheet to a Database*
  - ***Standardized form for inputting data***
  - ***Formulas reside in one location vs cells or fields***
    - ***Making global changes easier***
    - ***Less chance for errors***
  - ***Reports are flexible - they don't have to look like your entry form***
  - ***Query's have greater utility and complexity***
  - ***Data security***
  - ***Information can be transitioned from spreadsheet to database easier than from database to spreadsheet***
    - ***Spreadsheets can be used to test and validate formulas then imported into the database.***

Wallops RF Program

The Process for new or modified sources is initiated through the Frequency Manager

Frequency Manager:

- ***Coordinate RF spectrum utilization planning for new and existing frequencies.***
- ***Evaluate requests for utilization of specific frequencies and make operational impact recommendations to the Director of SSOPD (this one includes collecting info from NOAA, SCSC, WFF TD and WFF Safety).***
- ***Investigate and attempt to resolve RF interference affecting operations at GSFC/WFF.***
- ***Coordinate frequency utilization activities with other spectrum users in the surrounding area.***
- ***Coordinate frequency utilization activities with other spectrum users in the US and territories.***
- ***Obtain/maintain radio frequency authorizations from NTIA when required.***

User completes WFUMWG request form-

WALLOPS FREQUENCY UTILIZATION MANAGEMENT WORKING GROUP: FREQUENCY UTILIZATION REQUEST

Wallops RF Program (WFUMWG)

GSFC/Wallops Flight Facility

WALLOPS FREQUENCY UTILIZATION MANAGEMENT WORKING GROUP

FREQUENCY UTILIZATION REQUEST

IT IS REQUESTED THAT THE INDICATED FREQUENCY BE REVIEWED FOR USE AT THE GSFC/WFF.

1. FREQUENCY: **2790 – 2810 MHz**
2. ORGANIZATION:
3. PROJECT: **TRMM (Tropical Rain Measurement Mission)**
4. SPECIFY ALL COORDINATION REQUIREMENTS FOR AREAS OR ORGANIZATIONS OUTSIDE WALLOPS FLIGHT FACILITY:
5. SPECIFY ALL COORDINATION REQUIREMENTS FOR AREAS OR ORGANIZATIONS WITHIN WALLOPS FLIGHT FACILITY (NASA OR TENANTS): **Routine**
6. STATION CLASS: **SMD**
7. BANDWIDTH/EMISSION: **8M00P0N**

WFUMWG

8. IF A FREQUENCY BAND IS REQUESTED, DOES SYSTEM OPERATE ON DISCRETE FREQUENCIES IN THE BAND, SPREAD SPECTRUM, FREQUENCY HOPPING, OR HOW? **Discrete**

9. ORGANIZATION/PROJECT CONTACT:

10. CONTACT PHONE NUMBER:

11. DESCRIPTION OF HOW FREQUENCY WILL BE USED, METHOD OF OPERATION, ETC.: **Pulsed radar, used for meteorological research.**

11. PERIOD OF USAGE, (INCLUDE OVERALL TIME FRAME, DAYS/WEEK, HOURS/DAY OF PROJECTED USAGE OR OTHER NARRATIVE DESCRIPTION): **Indefinite, primarily normal workdays and hours, but some usage on weekends and at night depending on project requirements.**

File No. 597A

10. TRANSMITTER DATA

A. NOMENCLATURE: **Enterprise Electronics Corp. DWSR-8500S**

B. LOCATION:

1. **Bldg. U-20 tower**
2. **Bldg E-134 tower**
3. **On "Seatainer" near Bldg. E-134 Tower (Field Setup)**

C. TRANSMITTER PEAK POWER OUTPUT: **850 Kw**

D. TRANSMITTER AVERAGE POWER OUTPUT: **1020 watts**

E. PULSE WIDTH: **0.8 us or 2.0 us (selectable)**

F. MAXIMUM DUTY CYCLE: **0.0012 or 0.12%**

G. PULSE REPETITION FREQUENCY: **250 pps - 1200 pps (duty cycle limited)**

H. STABILITY: **3 parts in 10^7 (0.00003%)**

I. ANTENNA TYPE: **Planar Array simulating parabolic reflector**

J. ANTENNA HEIGHT ABOVE GROUND: **~47 ft. (on U-20 tower)**
~37 ft. (on E-134 tower)
~30 ft. (on "seatainer")

WFUMWG

K. ANTENNA POLARIZATION: **Dual Polarized (Simultaneous Horizontal and Vertical)**

L. ANTENNA GAIN: **40 dB**

M. ANTENNA, FIXED OR ROTATABLE: **Azimuth: 360°**
Elevation: –3° to 185°

N. ANTENNA, BEAM WIDTH - AZ: **1.5º**

O. ANTENNA, BEAM WIDTH - EL: **1.5°**

P. FIXED ANTENNA DIRECTION OF RADIATION: **NAP**

Q. TRANSMISSION SYSTEM ATTENUATION LOSSES: **1 dB. approx.**

R. ANTENNA LATITUDE AND LONGITUDE:
U-20 tower: 37º51'23"N; 75º30'41"W
E-134 tower: 37º56'07"N; 75º28'23"W
Seatainer near E-134 tower: ~37º56'07"N; ~75º28'23"W

14. RECEIVER DATA

A. NOMENCLATURE: **DWSR-8500S**

WFUMWG

B. LOCATION:

1. **Bldg. U-20 tower**
2. **Bldg E-134 tower**
3. **On “Seatainer” near Bldg. E-134 Tower (Field Setup)**

C. STABILITY: **2.5 ppm (0.00025%)**

D. SENSITIVITY: **-114 dBm**

E. ANTENNA TYPE: **Planar Array simulating parabolic reflector**

F. ANTENNA POLARIZATION: **Dual Polarized (Simultaneous Horizontal and Vertical)**

G. ANTENNA GAIN: **40 dB**

H. ANTENNA, FIXED OR ROTATABLE: **Azimuth: 360°**
Elevation: -3° to 185°

I. ANTENNA, BEAM WIDTH - AZ: **1.5°**

J. ANTENNA, BEAM WIDTH - EL: **1.5°**

K. FIXED ANTENNA DIRECTION OF PATTERN: **NAP**

L. ANTENNA LATITUDE AND LONGITUDE:

U-20 tower: 37º51'23"N; 75º30'41"W
E-134 tower: 37º56'07"N; 75º28'23"W
Seatainer near E-134 tower: ~37º56'07"N; ~75º28'23"W

15. HAS FREQUENCY ALREADY BEEN ASSIGNED TO ORGANIZATION BY NTIA OR FCC FOR AREA IN WHICH IT WILL BE USED? **Yes. Serial numbers NASA010002, NASA010003, NASA010006 and NASA010007.**

16. MISCELLANEOUS COMMENTS:
This file is being reevaluated to add a third location (near the Bldg. E-134 tower). The radar will be setup on a "seatainer" as it is configured on the field.

SIGNATURE ____________ DATE

Safety Evaluation

3. WFF Safety Office

Information received via Frequency Utilization Request is entered in the database to determine the following:

HERP (Hazards of Electromagnetic Radiation to Personnel)

HERO (Hazards of Electromagnetic Radiation to Ordinance)

Note: HERF (Fuels) are not performed

*After Evaluation the following report is generated and becomes a part of the **WFUMWG***

RF RADIATION HAZARD EVALUATION

System/Equipment: **DWSR-85008**

FREQUENCY: 2790-2810 MHz

Comments, Restrictions, Etc.

HERP (Mainbase)
The permissible exposure limit at the lowest proposed frequency is 1.9 mW/cm^2 for an uncontrolled environment like the Mainbase. The calculated hazard distance for a fixed antenna is 186 meters (611 feet) based on a 1020 watts max average power. If no controls are established to prevent continuous exposures, cut outs or limitations on minimum angle of depression shall be established to avoid potential over exposure to personnel interference problems within the buildings listed below.

Building	Range (ft)	Bearing Degrees true	Min Depression On Seatainer	Min Depression on E-134 Tower
E-107	552	351-11	2.5	1.75
E-108	475	345-8	2.7	1.9
E-134	27	265-15	-11.2	-24.5
E-144	414	276-280	0.1	-0.8
N-116	200	78-107	-1.5	-3.4
N-117	380	95-110	-.4	-1.5
Ground	611	Any	-1.1	-1.8

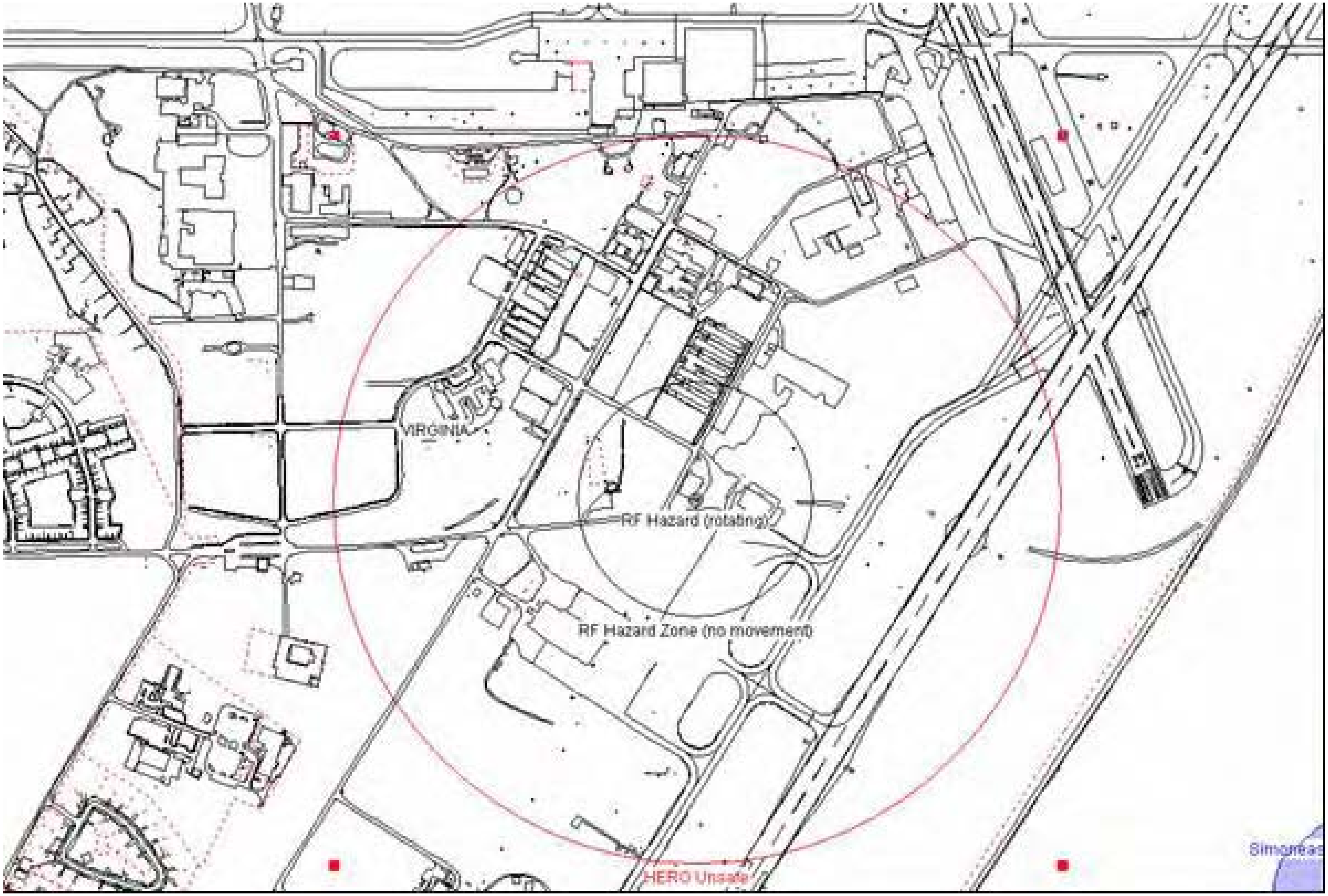
This calculation assumes a nominal 10-foot person on top of the building. A minimum depression angle of 2.7 (seatainer) and 1.9 (E-134 tower) protects personnel without regard to azimuth. Lower elevations, –1.1 (seatainer) and –1.8 (E-134 Tower), can be achieved with cutouts. Procedures to reduce potential exposure time could be used after approval by the Safety Office. These would require positive controls to be identified.

HERO (Mainbase)
An RF hazard to ordnance exits out to about 575 meters (1888 feet) for HERO unsafe ordnance. The Ordnance hazard distance includes the ramp around N-159. Since aircraft carrying/installing ordnance devices may be in this area, the minimum depression angle must be to prevent more than 0.19 mW/cm^2 in this area is 0.14 degrees elevation for bearing 126 thru 229.

No analysis has been done for interference with WOTS or NOAA.

GSFC/Wallops
Flight Facility

WFUMWG (MARPLOT) Main Base



WFUMWG

HERP (ISAND)

The permissible exposure limit at the lowest proposed frequency is 9.3 mW/cm^2 for an controlled environment like the Mainbase. The calculated hazard distance for a fixed antenna is 83 meters (273.2 feet) based on a 1020 watts max average power. If no controls are established to prevent continuous exposures, cut outs or limitations on minimum angle of depression shall be established to avoid potential over exposure to personnel interference problems within the buildings listed below.

Building	Range (ft)	Bearing Degrees true	Min Depression On U-20 Tower
U-25	282	215-312	-3.4
U-26	247	287-292	-4.0
U-27	196	228-236	-5.3
U-30	598	216-222	-1.2
U-40	380	26-40	-2.3
Ground	273	Any	-7.0

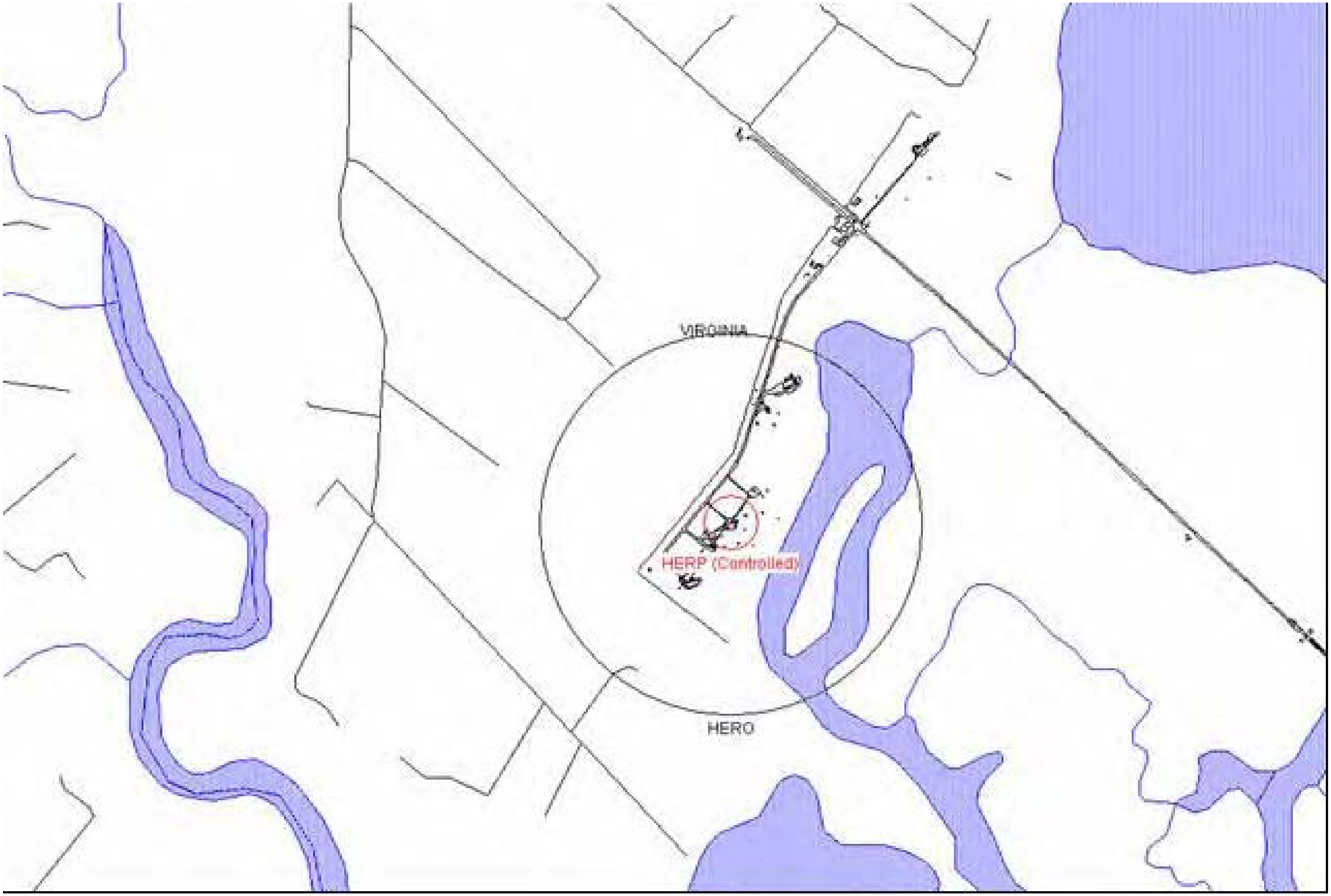
This calculation assumes a nominal 10-foot person on top of the building. A minimum depression angle of –1.2 (U-40 tower) protects personnel without regard to azimuth.

HERO (Island)

An RF hazard to ordnance exits out to about 575 meters (1888 feet) for HERO unsafe ordnance. This does not impact any normal explosives operations on the Island. See Drawing

GSFC/Wallops Flight Facility

WFUMWG (MARPLOT) Mainland



WFUMWG

No analysis has been done for interference with WOTS or NOAA.

This system/equipment and frequency are approved for use as requested without restrictions unless noted above.

RF Safety Officer Date
NASA/GSFC/WFF

File No. 597A
Equipment Code NA282

DATABASE

Wallops Flight Facility

Radio Frequency Emitters and Safety Analysis

Database Formulas:

- HERP is based on the IEEE STD
- HERO is based on the OP 3565 modified (NAVSEA STD)

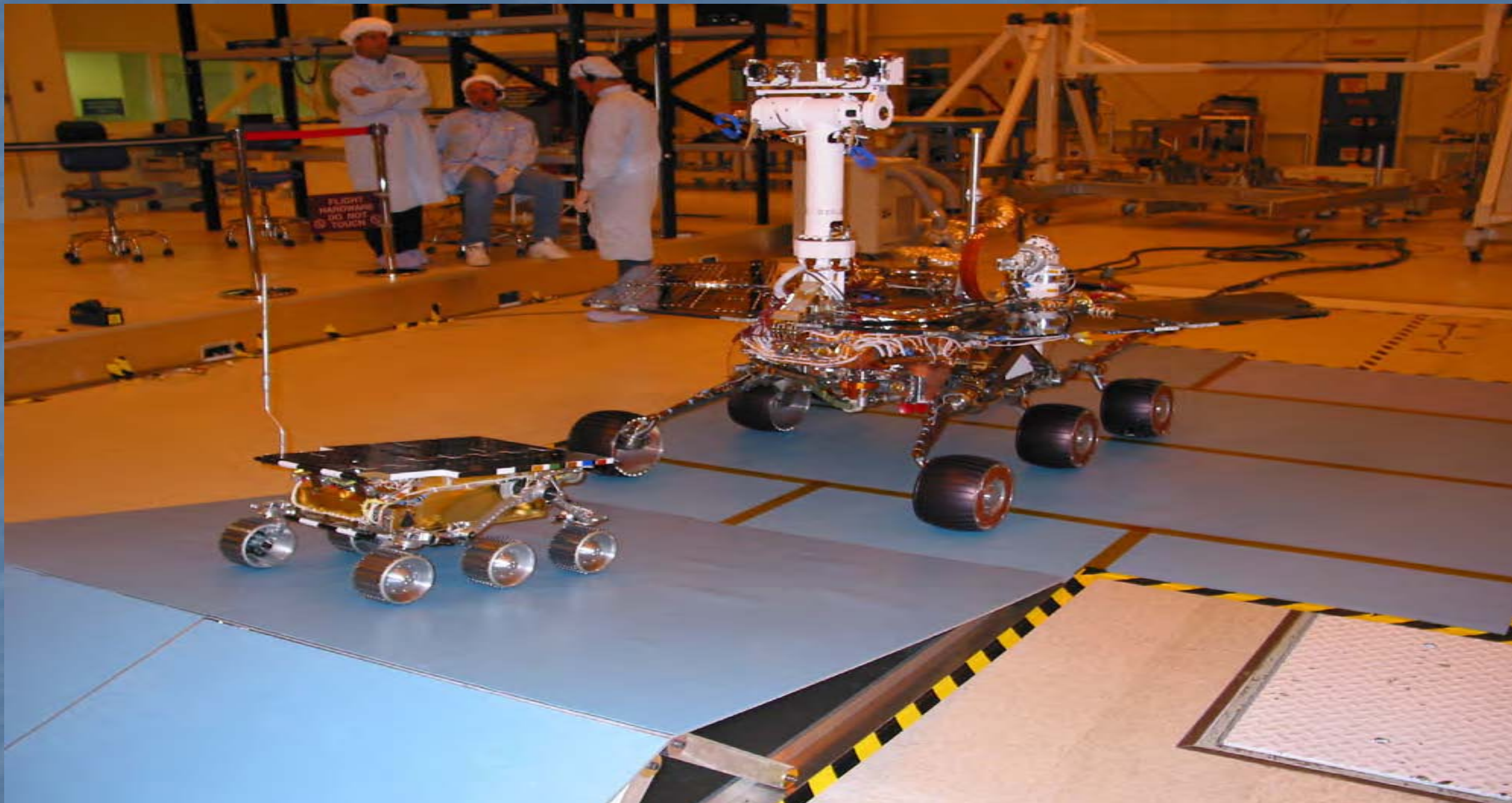
Mars Science Lab Launch Support at KSC

R. Scott and E. Provost

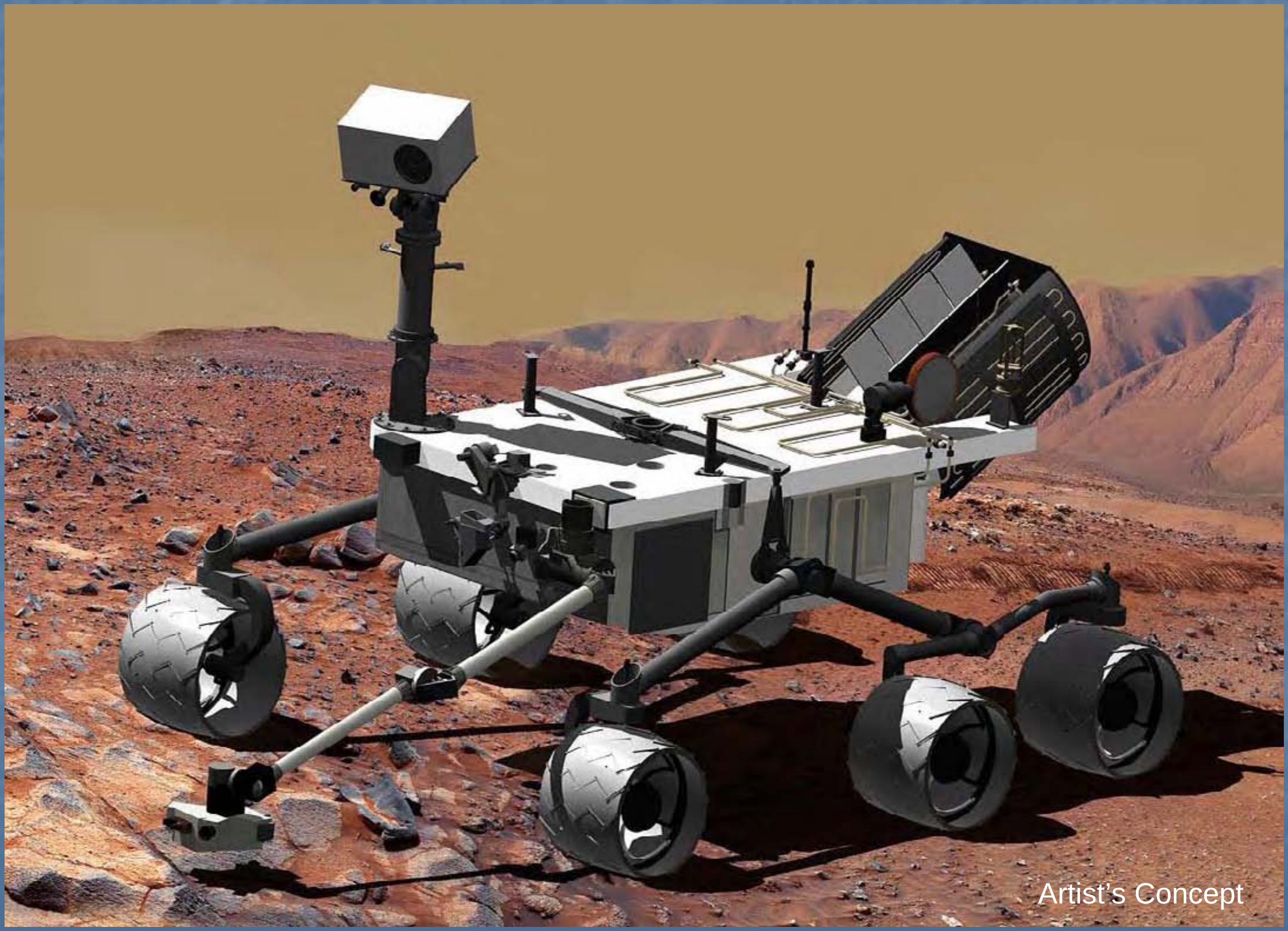
Kennedy Space Center

5/16/2008

FIRST PATHFINDER THEN MER



NOW MARS SCIENCE LABORATORY



Mission Overview

- Its mission: investigate the past or present potential of Mars to support microbial life.

  Plans for the Mars Science Laboratory call for launch from Cape Canaveral Air Force Station, Florida, In September or October 2009 and arrival at Mars in summer 2010.

Research Objective

The science goal is to assess whether the landing area ever had or still has environmental conditions favorable to microbial life.

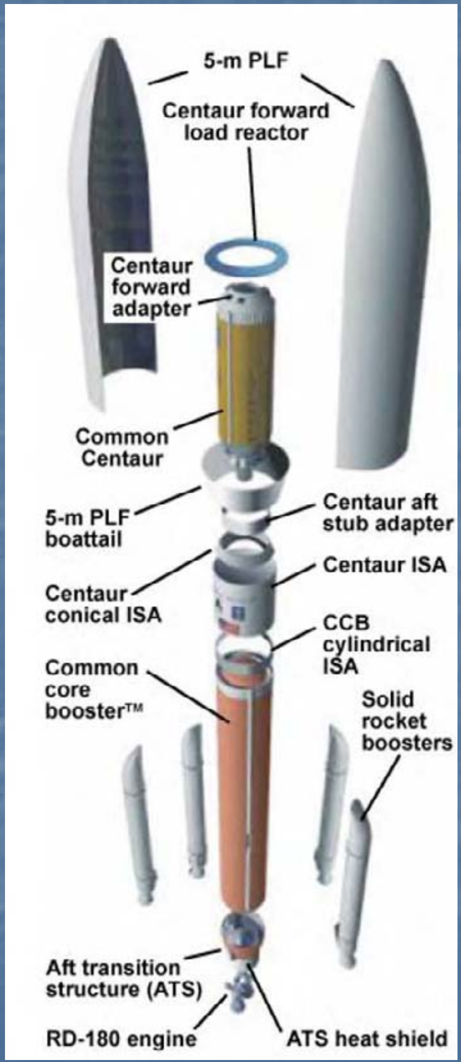
Investigations to support this objective

- Detecting and identifying any organic carbon compounds
- Making an inventory of the key building blocks of life
- Identifying features that may represent effects of biological processes
- Assessing how Mars' atmosphere ahs changed over billions of years
- Determining current distribution and cycles of water and carbon dioxide

Science Payload

- Gas chromatograph
- Mass Spectrometer
- Laser Spectrometer
- X-Ray Diffraction and Fluroescence
- Alpha Particle X-Ray Spectrometer
- Radiation Assessment Detector
- Environmental Monitoring Station
- Dynamic Albedo of Neutrons Instrument

Atlas V 541 Launch Vehicle



MSL Cruise Stage w/Spacecraft

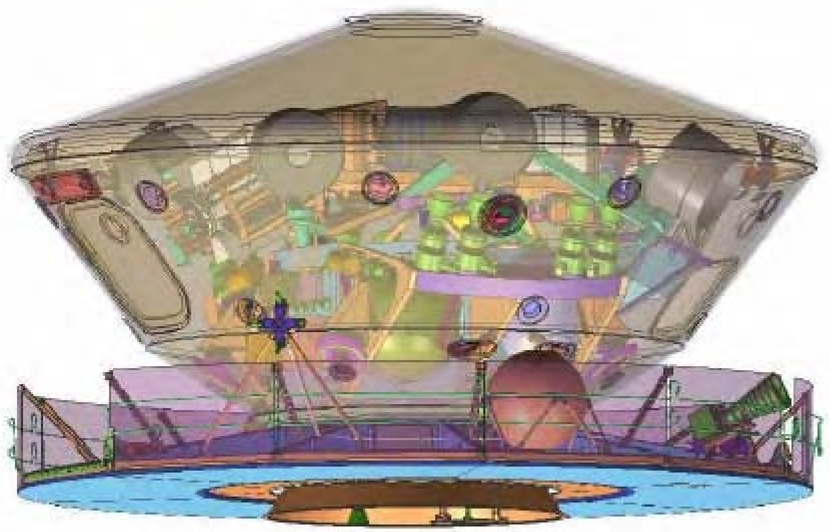


Figure 3.2-3. Cruise Stage with spacecraft

MSL Spacecraft

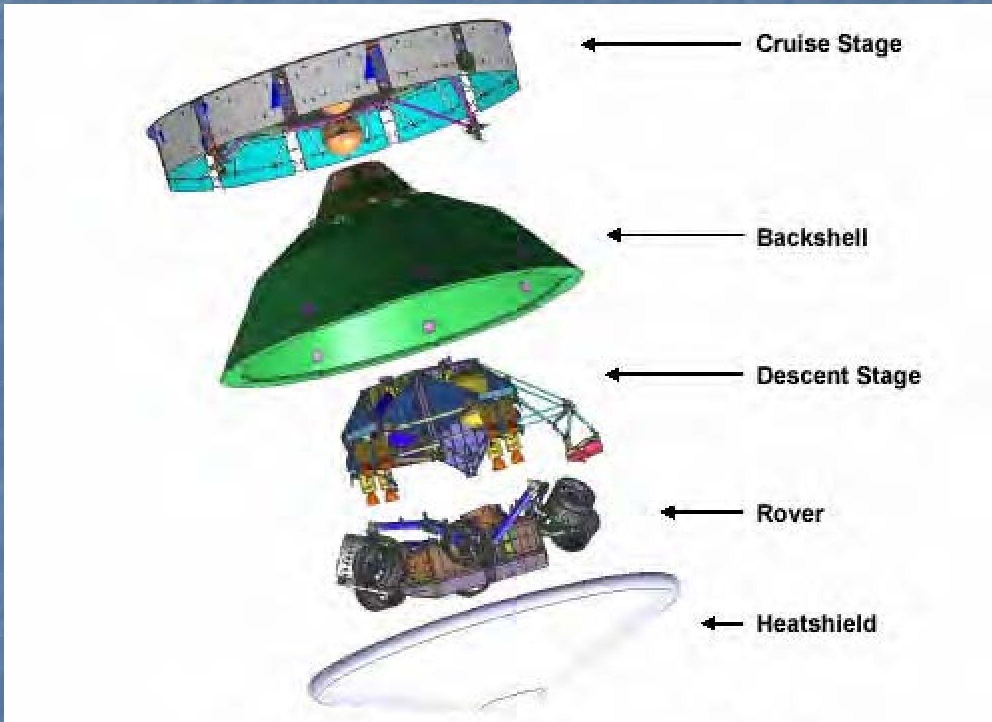


Figure 3.2-1. MSL Spacecraft, Expanded View of Elements

MSL Rover

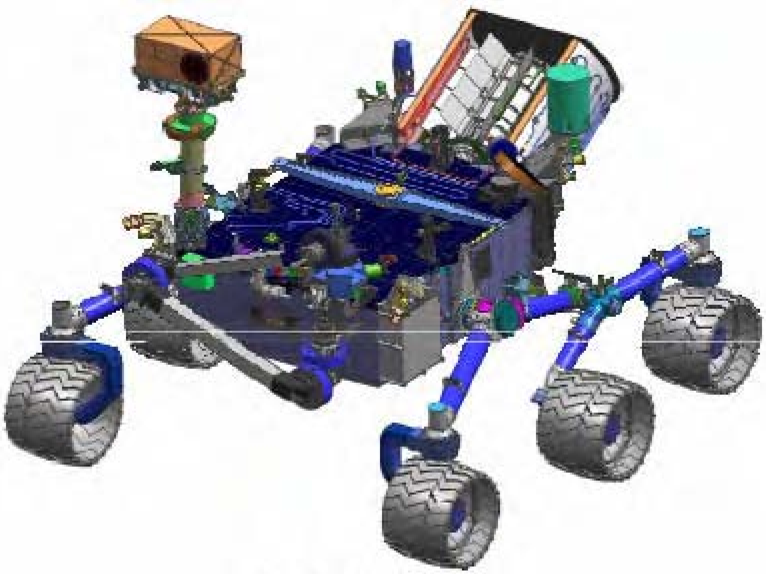
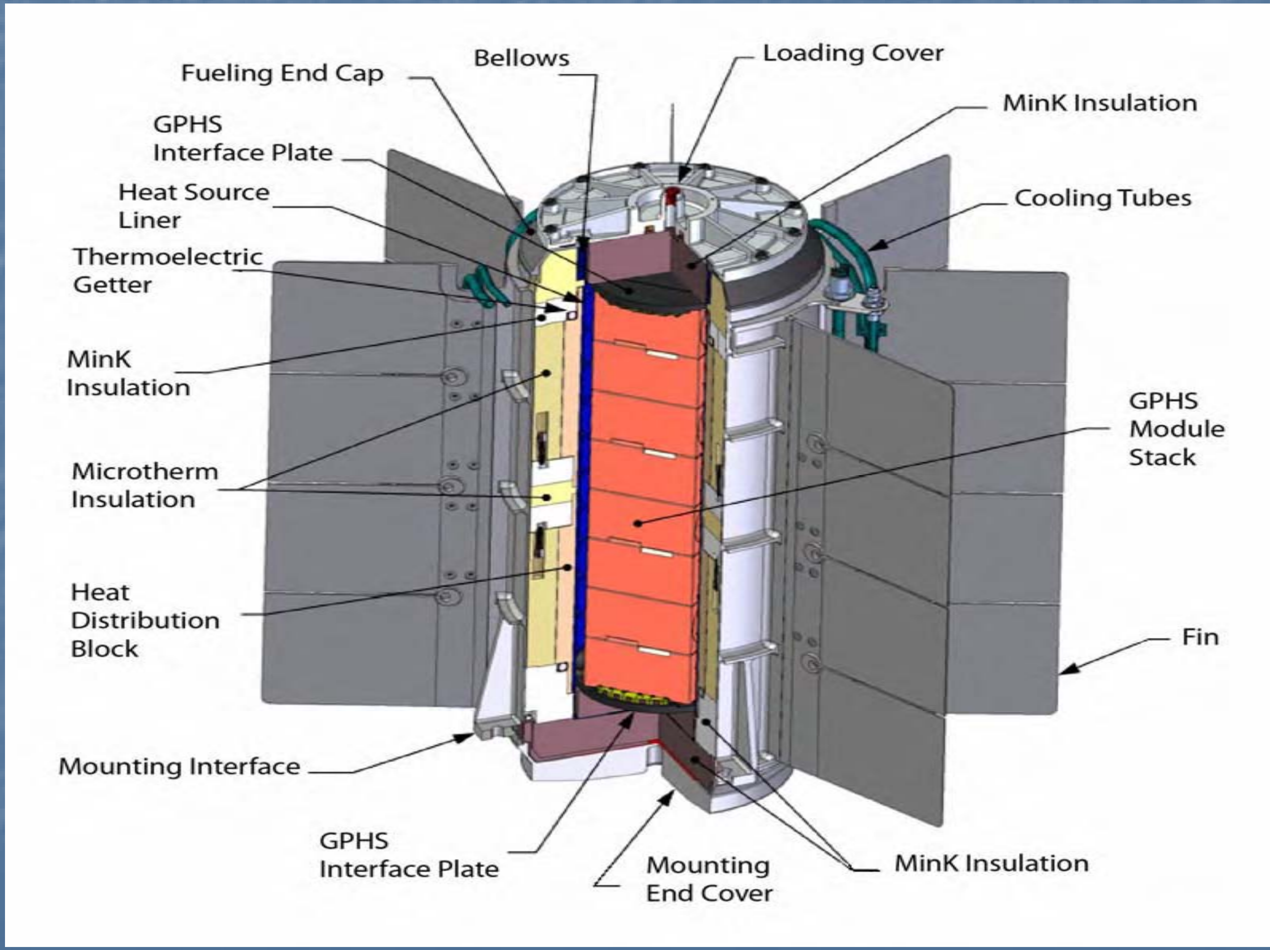


Figure 3.2-9. MSL Rover

History of RTG'S In Space

- Two types of Radioisotope Systems
  - Power generators (10's to 100's of Watts) and Heater units (1 Watt thermal)
- Long history of use in space
  - First launch in 1961
  - Used safely and reliably in missions for 40 years
    - 6 on the Moon (1960s - 1970s)
    - 8 in Earth orbit (1960s - 1970s)
    - 5 on Mars (1970s & RHUs 1996/2003)
    - 8 to outer planets and the Sun (1970s - 2006s

Multi-Mission Radioisotope Thermoelectric Generator



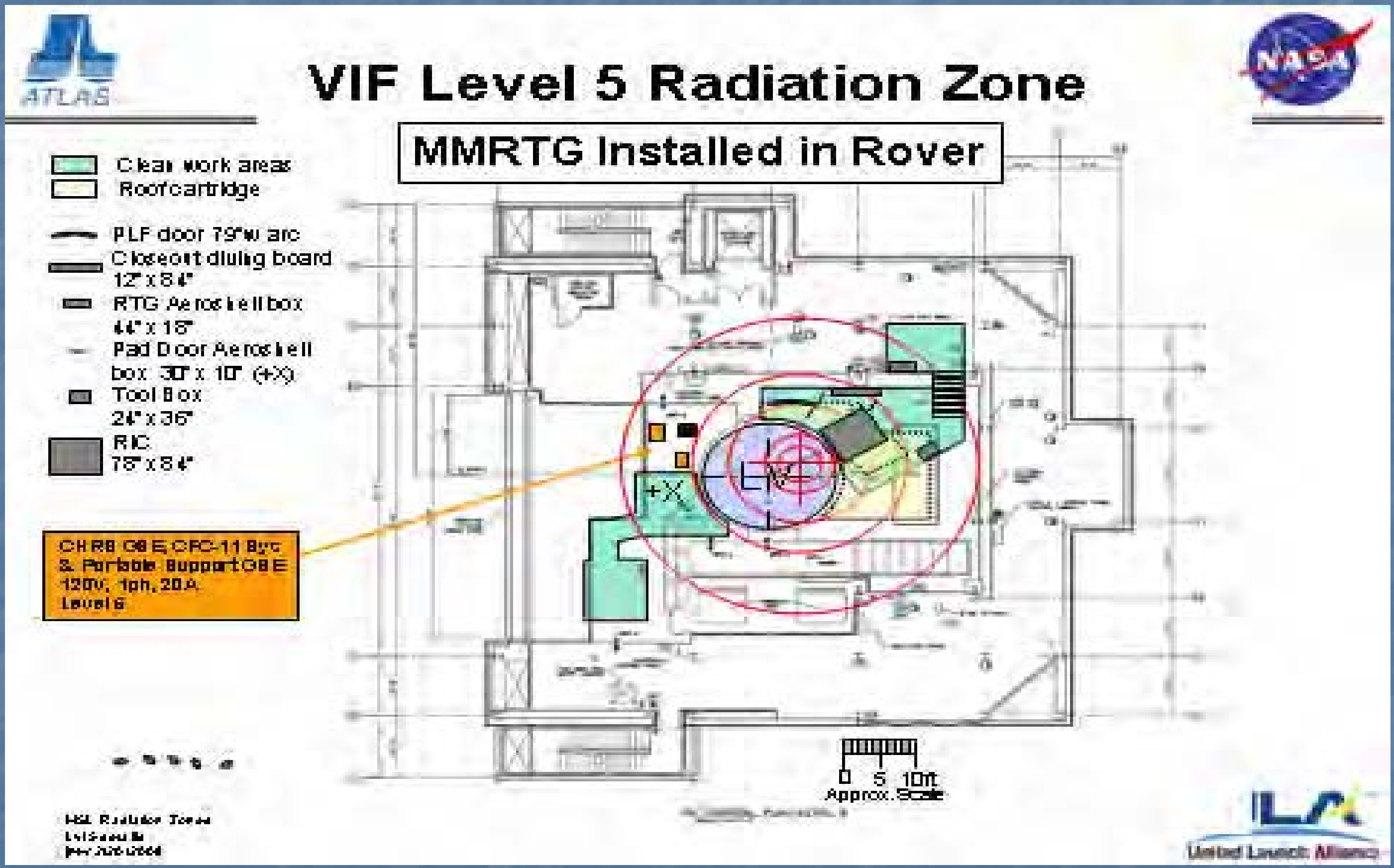
MMRTG

1900 Watt thermal MMRTG
100 Watt electrical
8 GPHS Modules
4800 g PuO2
60,000 Ci

General Purpose Heat Source-Step 2

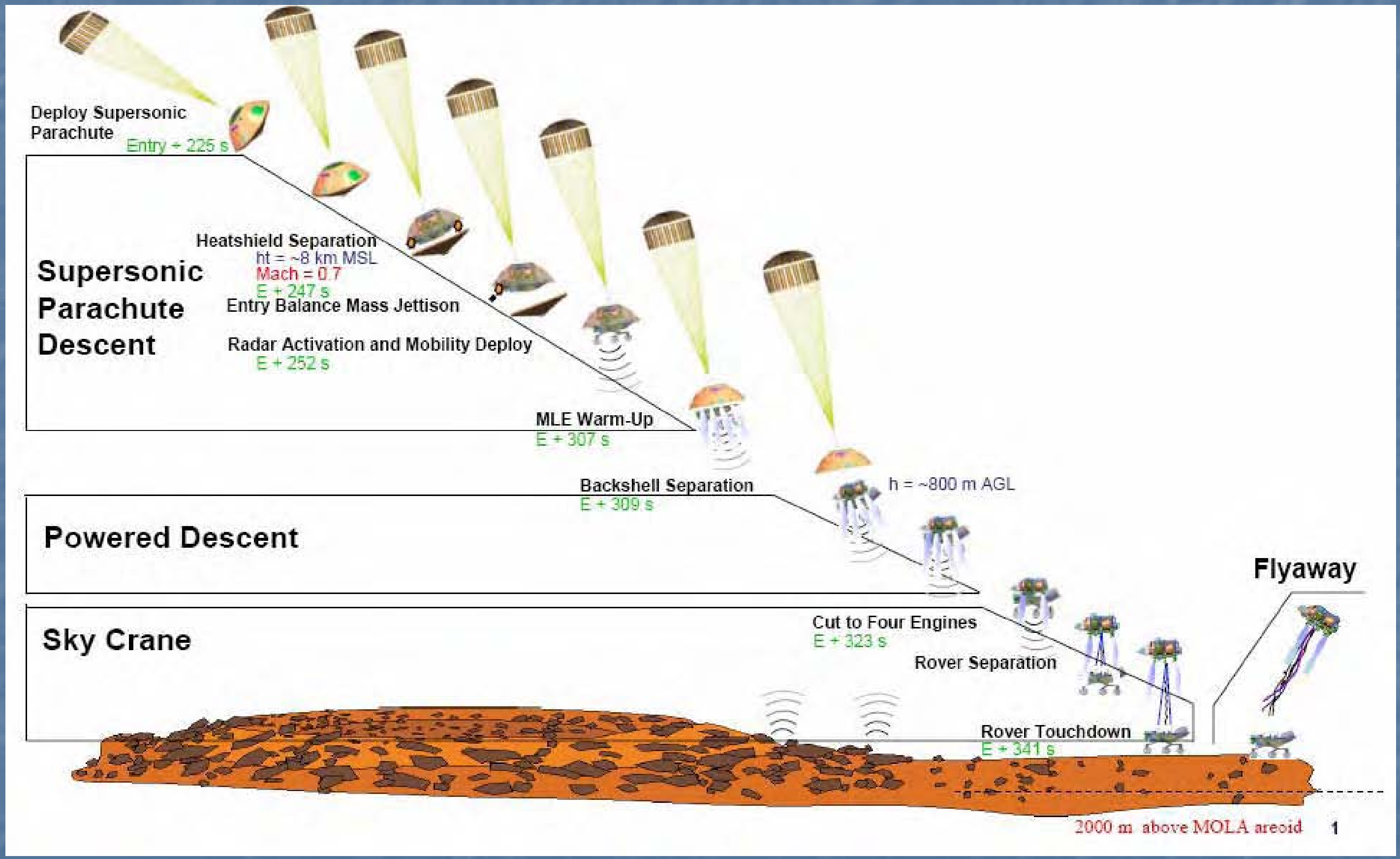
Figure 2.1-4. Cutaway View of a Step-2 GPHS Module

VIF RADIATION ZONES



Go For Launch

MSL Landing Sequence



Agency Health Physics Policy

K. Geber

Agency Health Physics

5/16/2008

Agency Health Physics

Kurt Geber, CHP

2008 NASA Health Physics Conference

May 16, 2008

NASA regulates the use of Class 3b and 4 lasers.

Laser

From Wikipedia, the free encyclopedia

For other uses, see Laser (disambiguation).

A **laser** is an electronic-optical device that emits coherent light radiation. The term "laser" is an acronym for *Light Amplification by Stimulated Emission of Radiation*.[1] A typical laser emits light in a narrow, low-divergence monochromatic (single-coloured, if the laser is operating in the visible spectrum), beam with a well-defined wavelength. In this respect, laser light is in sharp contrast with such light sources as the incandescent light bulb, which emits light over a wide area and over a wide spectrum of wavelengths.

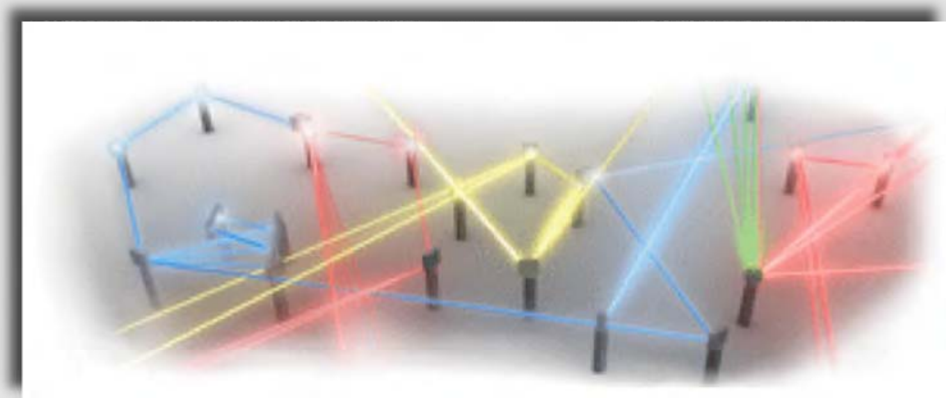
Experiment with a laser (U.S. Air Force)

The first working laser was demonstrated on May 16, 1960 by Theodore Maiman at Hughes Research Laboratories.[2] Recently, lasers have become a multi-billion dollar industry. The most widespread use of lasers is in optical storage devices such as compact disc and DVD players, in which the laser (a few millimeters in size) scans the surface of the disc. Other common applications of lasers are bar code readers, laser printers and laser pointers.

LASER

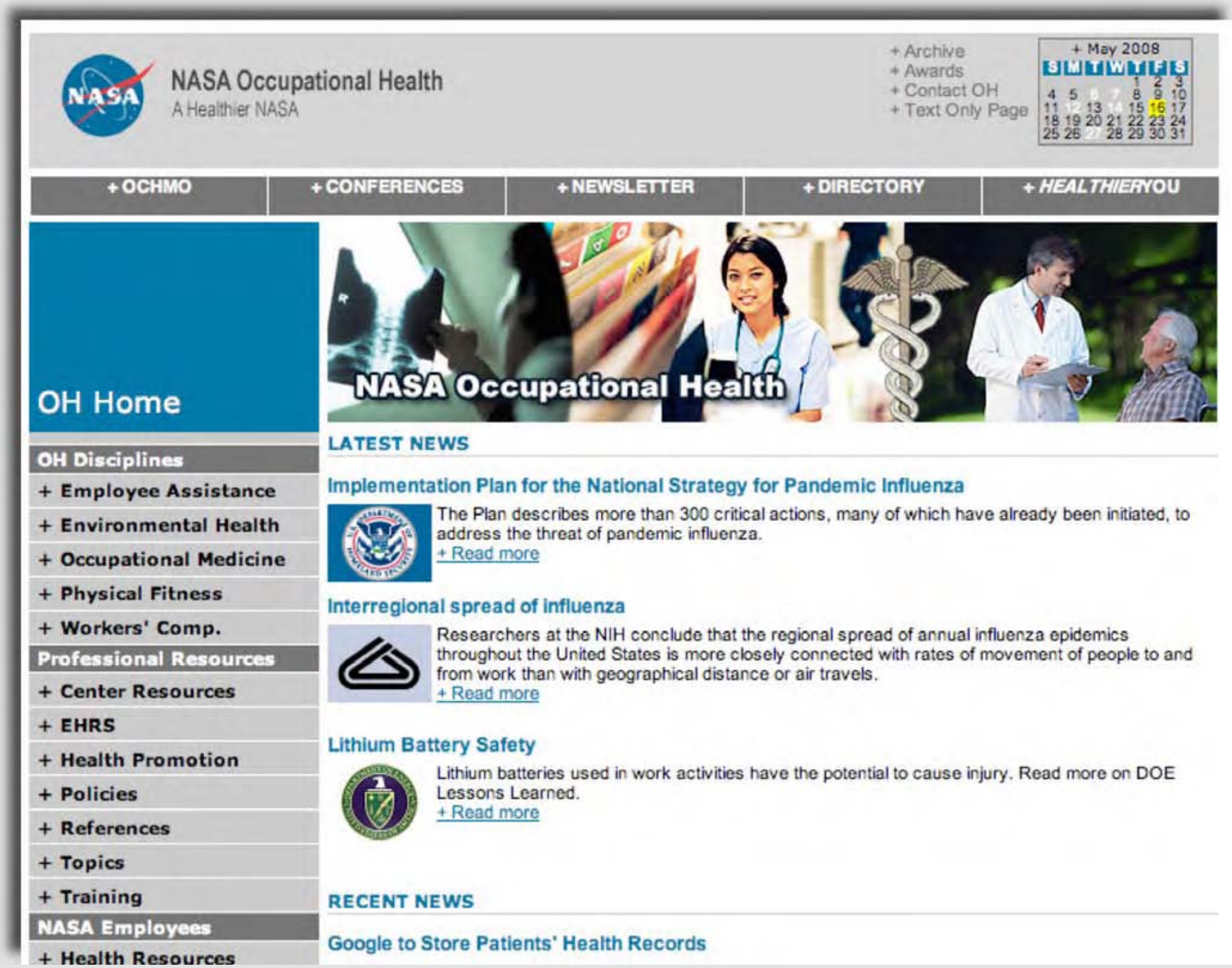
***L**ight*
***A**mplification by*
***S**timulated*
***E**mission of*
***R**adiation*

First Successfully Demonstrated
48 Years Ago Today



Thanks for remembering Google.

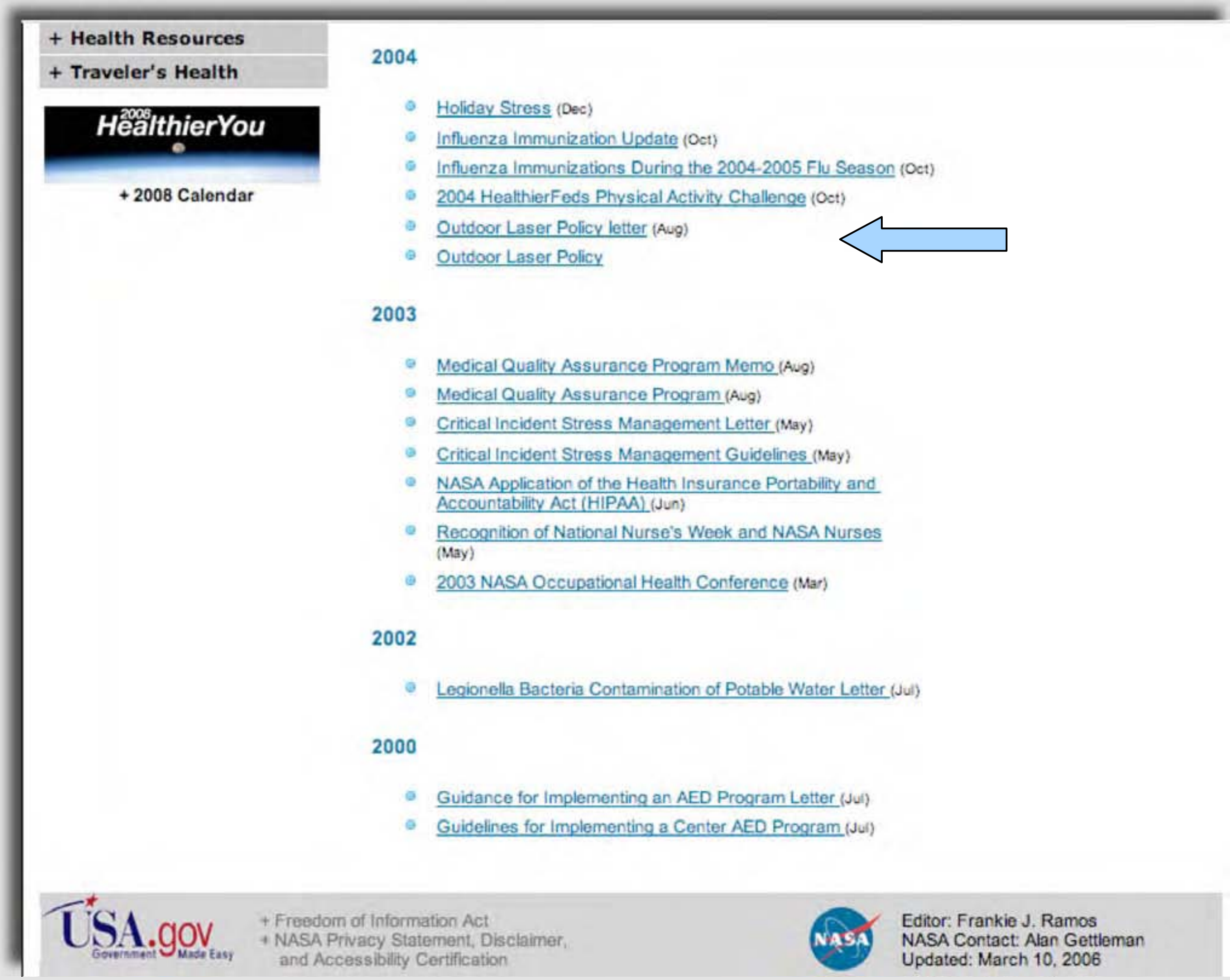
Resources for the Health Physicist on the NASA Occupational Health Website



NASA Policy:
Safe Use of Lasers Outdoors

Chief Health and Medical Office Communications on the OH Web

OCHMO Establishes NASA Policy August 2004



Centers coordinate efforts directly with other interested government agencies

National Aeronautics and
Space Administration

Office of the Administrator
Washington, DC 20546-0001

August 26, 2004

TO: Distribution

FROM: NASA Designated Agency Health and Safety Official

SUBJECT: Outdoor Laser Use

NASA laser usage has increased over the years. Inter-agency laser safety and high-intensity light use issues between NASA and Department of Defense (DoD)/Federal Aviation Administration (FAA) are currently handled at the Center level. Individual Centers coordinate with regional FAA representatives and the U.S. Space Command in Colorado Springs, Colorado.

Controls are needed to assure uniform implementation of requirements and guidelines Agency-wide, and to assure that inadvertent damage from NASA laser and high-intensity light

Dr. Richard Williams, MD
is OSHA's Designated Agency
Health and Safety Official

Key elements of outdoor laser policy

ANSI Std incorporated by reference

Applies only to hazardous emissions

Outdoor Lasers:

Unless otherwise noted, all ANSI Z136.6, *American National Standard for Safe Use of Lasers Outdoors*, recommendations are incorporated by reference as requirements, and will take precedence over any less rigorous requirement in this document.

Outdoor laser use covered by this policy covers all uses of Class 3b and 4 lasers; whether, ground based, air based, or space based, where the direct beam extends ind
the insertion of a mirror into the output beam path could create a specular r
extends indefinitely. For more information see the final Office of Aviation
ser Pointers: Their Potential Affects on Vision and Aviation Safety,

Requires written procedures

Establishes LSO authority

All laser beams propagated in outdoor areas shall follow written procedures that are approved by the Center Laser Safety Officer (LSO). The Center LSO has the authority to invoke the

Coordination and Notifications

and shall be followed by either email or fax written report. If the Agency Environmental Health Officer is unavailable, notification shall be to the OCHMO office in Washington, DC, (202) 358-1794 or (202) 358-2329.

The following steps shall be taken prior to outdoor laser use:

- Centers shall coordinate directly with regional FAA points of contact using the protocols found in FAA Order 7400.2E, Procedures for Handling Airspace Matters, Part 6. MISCELLANEOUS PROCEDURES, Chapter 29. OUTDOOR LASER OPERATIONS
- Additionally, requests for letters of non-objection that involve multiple FAA Regions shall be sent through the FAA at the Agency level.

  Reginald Mathews, Airspace & Rules Division Manager
  Air Traffic Airspace Management Program
  800 Independence Avenue, S.W.
  ATA-400, Room 423
  Washington, DC 20591
  Email: reginald.mathews@faa.gov
  Office Phone: 202-267-8783
- Centers shall continue to coordinate directly with U.S. Space Command at Cheyenne Mountain.

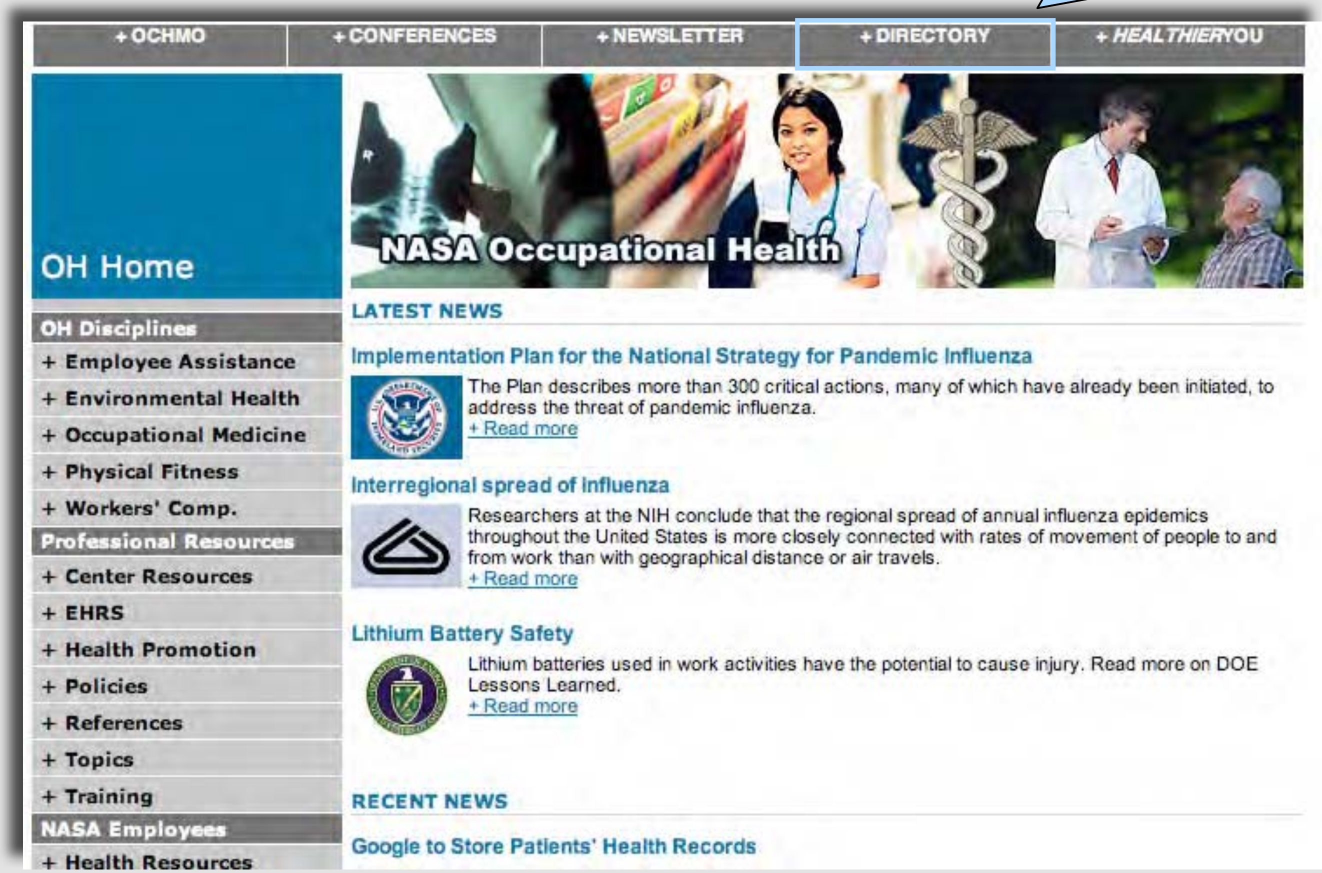
  North American Aerospace Defense Command
  CMOC/J3
  Attn: Orbital Safety Officer
  Cheyenne Mountain AFS, CO 80914-6020
  Laser Clearinghouse
  DSN 286-4416, (719) 474-4416
- Centers shall coordinate directly with local military commands on matters of outdoor laser use and associated controls for their airspace.
- Centers shall advise the NASA Senior Environmental Health Officer of all outdoor laser coordination with the FAA, U.S. Space Command, and/or local military commands via email, and shall copy the NASA Senior Environmental Health Officer on all outdoor laser correspondence with the FAA, U.S. Space Command, and/or local

FAA POCs

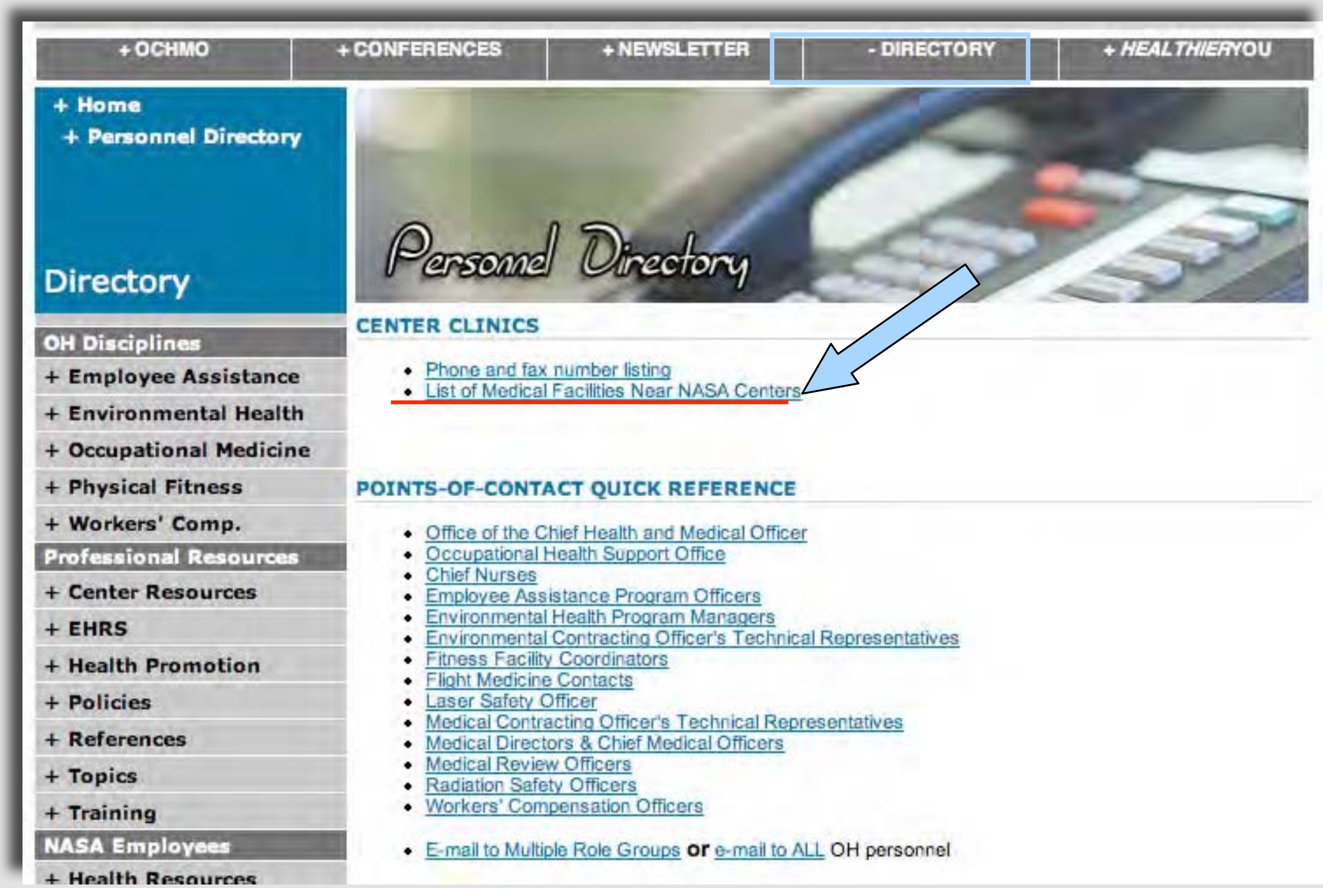
Now U.S. STRATCOM
Relocated to Vandenberg AFB

Mr. Guy Camomilli

Utilizing the Personnel Directory



OH Clinic Resources and POCs



Useful Link for the Business Traveler

+ OCHMO | + CONFERENCES | + NEWSLETTER | + DIRECTORY | + *HEALTHIER*YOU

+ Home

Center Clinics

OH Disciplines
- + Employee Assistance
- + Environmental Health
- + Occupational Medicine
- + Physical Fitness
- + Workers' Comp.

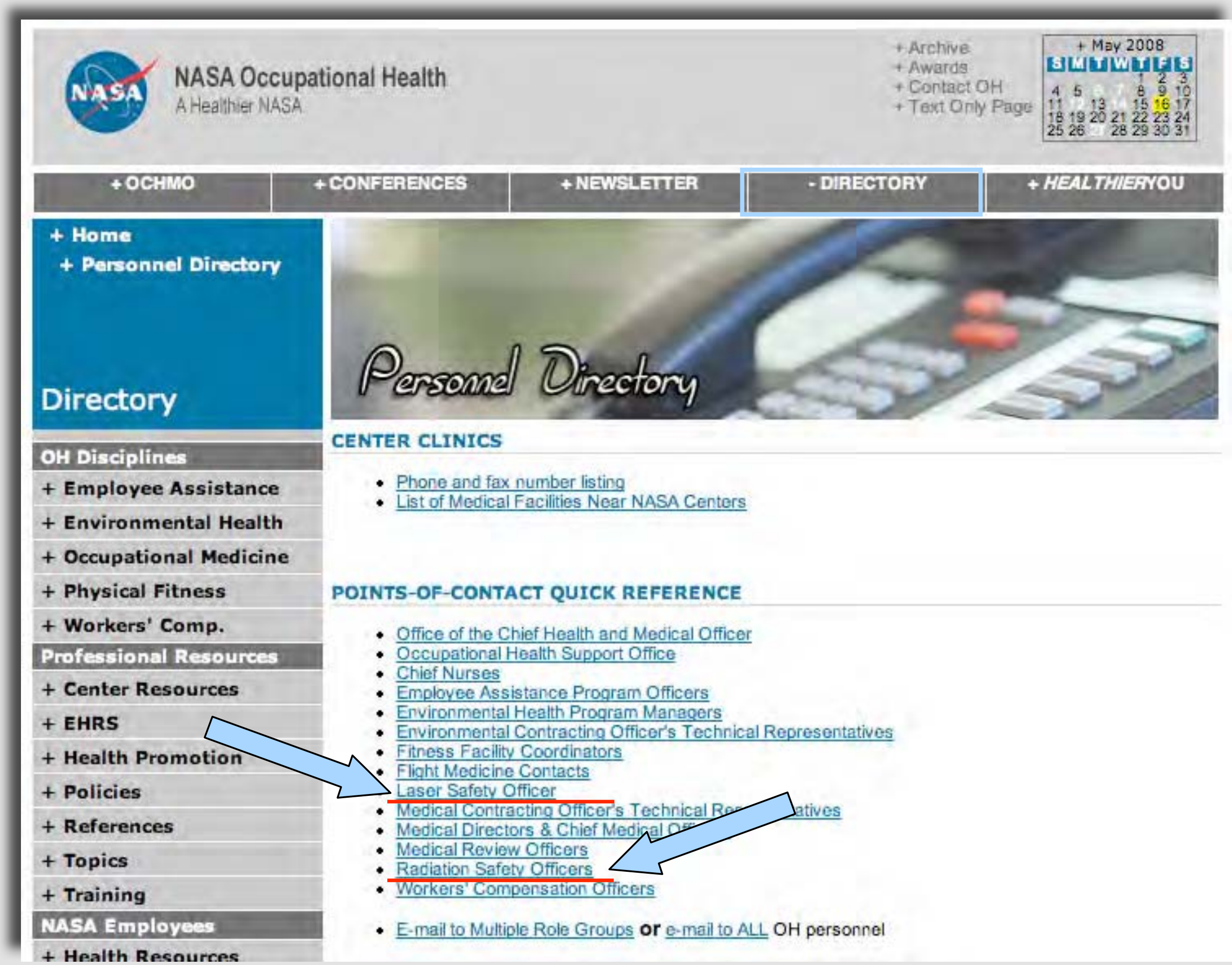
Professional Resources
- + Center Resources
- + EHRS
- + Health Promotion
- + Policies
- + References
- + Topics
- + Training

NASA Employees
- + Health Resources

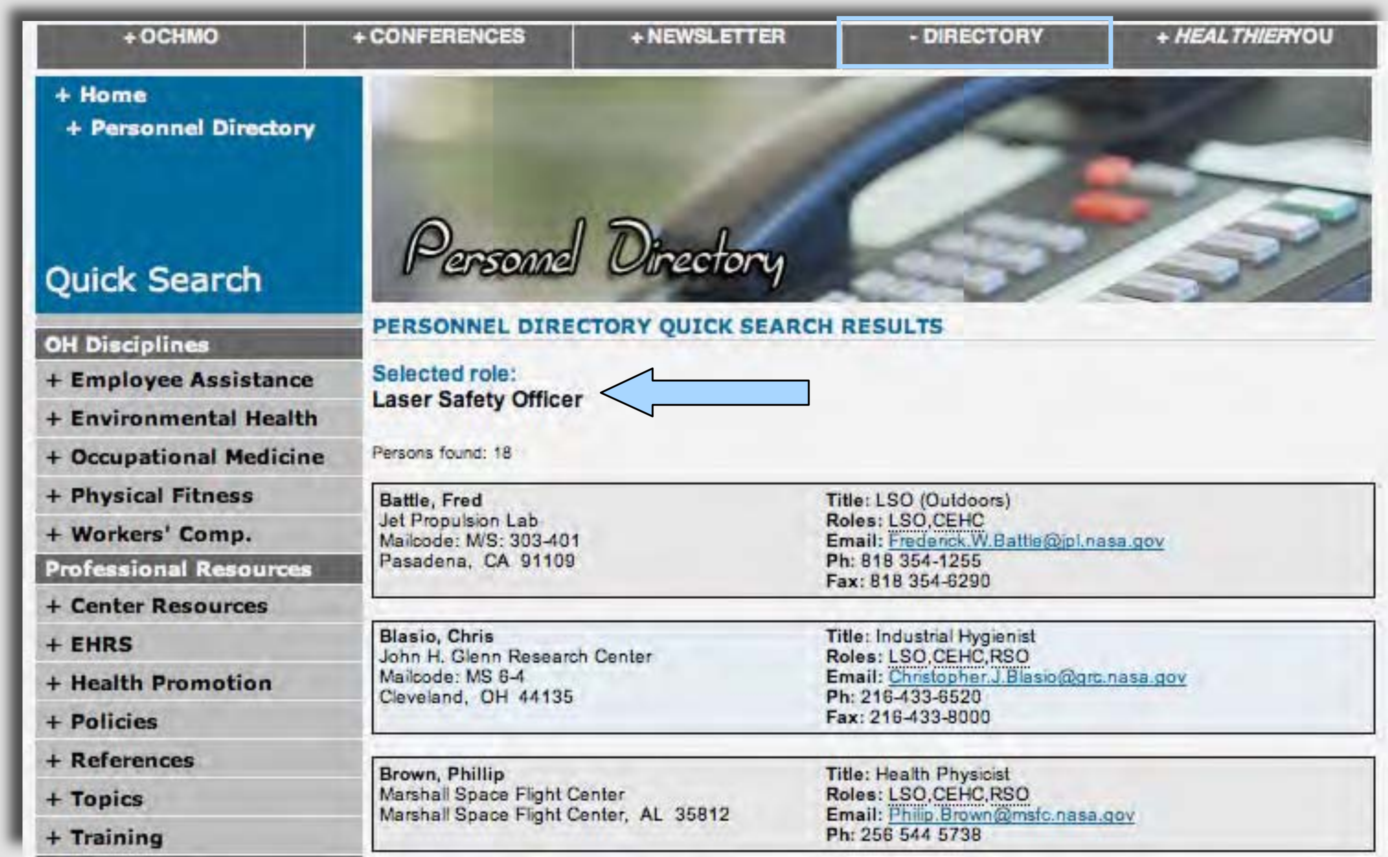
CLINIC CONTACT INFORMATION

Clinic at	Phone	Fax	Building
Ames Research Center	650-604-5287	650-604-0640	N215
Dryden Flight Research Center	661-276-3570	661-276-2392	4822
Goddard Space Flight Center	301-286-6666	301-286-1618	97
Headquarters	202-358-2600	202-358-3027	CD-70
Jet Propulsion Lab	818-35[illegible]-3319	818-393-4963	310
John H. Glenn Research Center	[illegible]433-5841	216-433-6529	15
Johnson Space Center	281-483-4111	281-244-5179	8
Kennedy Space Center	321-867-3346	321-867-2040	M6-495
Langley Research Center	757-864-3193	757-864-9114	1149
Marshall Space Flight Center	256-544-2390	256-544-5746	4249
Michoud Assembly Facility	504-257-2701	504-257-4425	320
Stennis Space Center	228-688-3810	228-688-7565	1100
Wallops Flight Facility	757-824-1266	757-824-1497	F160
White Sands Testing Facility	505-524-5212	505-524-5046	104

Health Physics Program POCs



Center Laser Safety Contacts

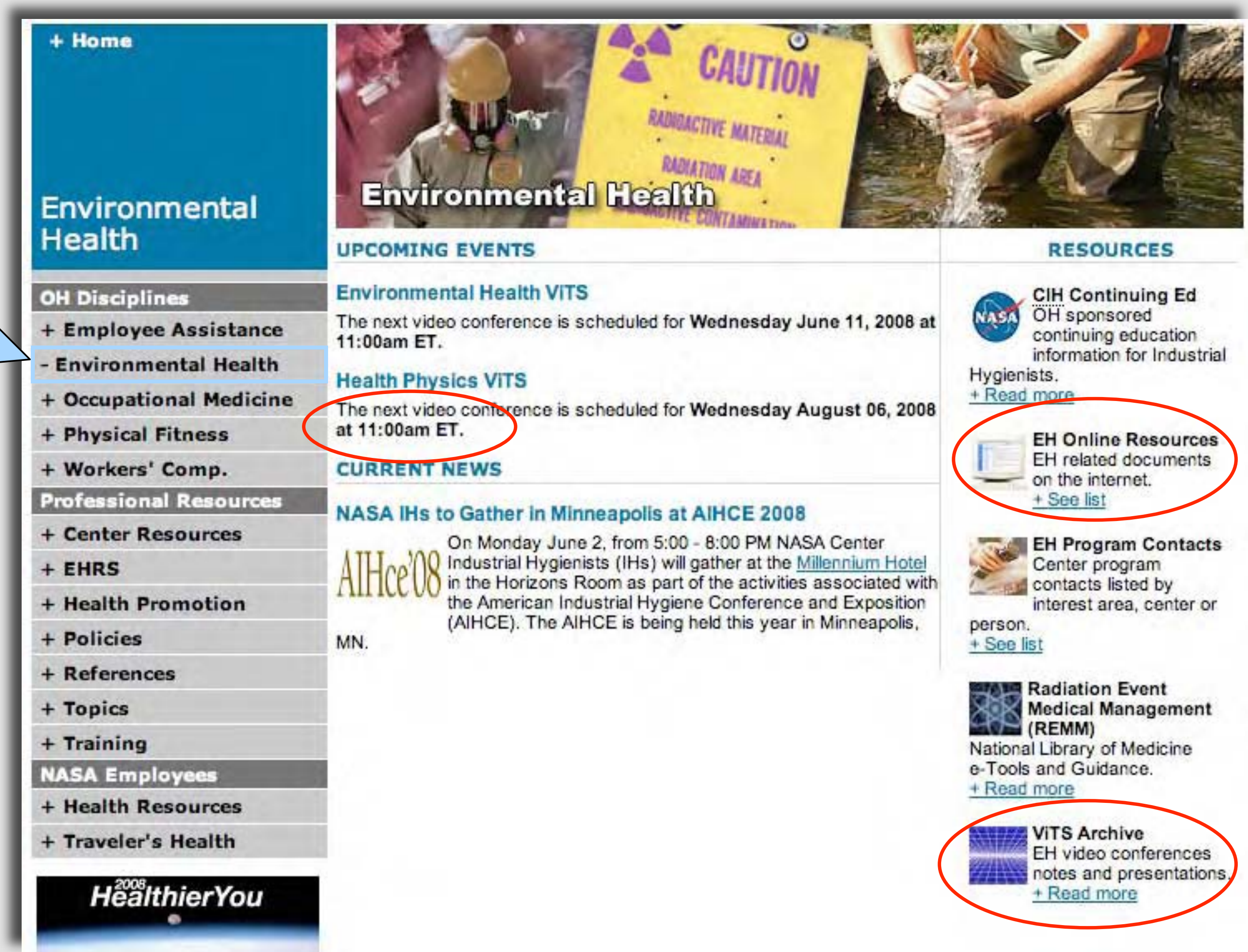


Lists primary laser safety contacts

Center Radiation Safety Contacts

Lists primary ionizing radiation safety contacts

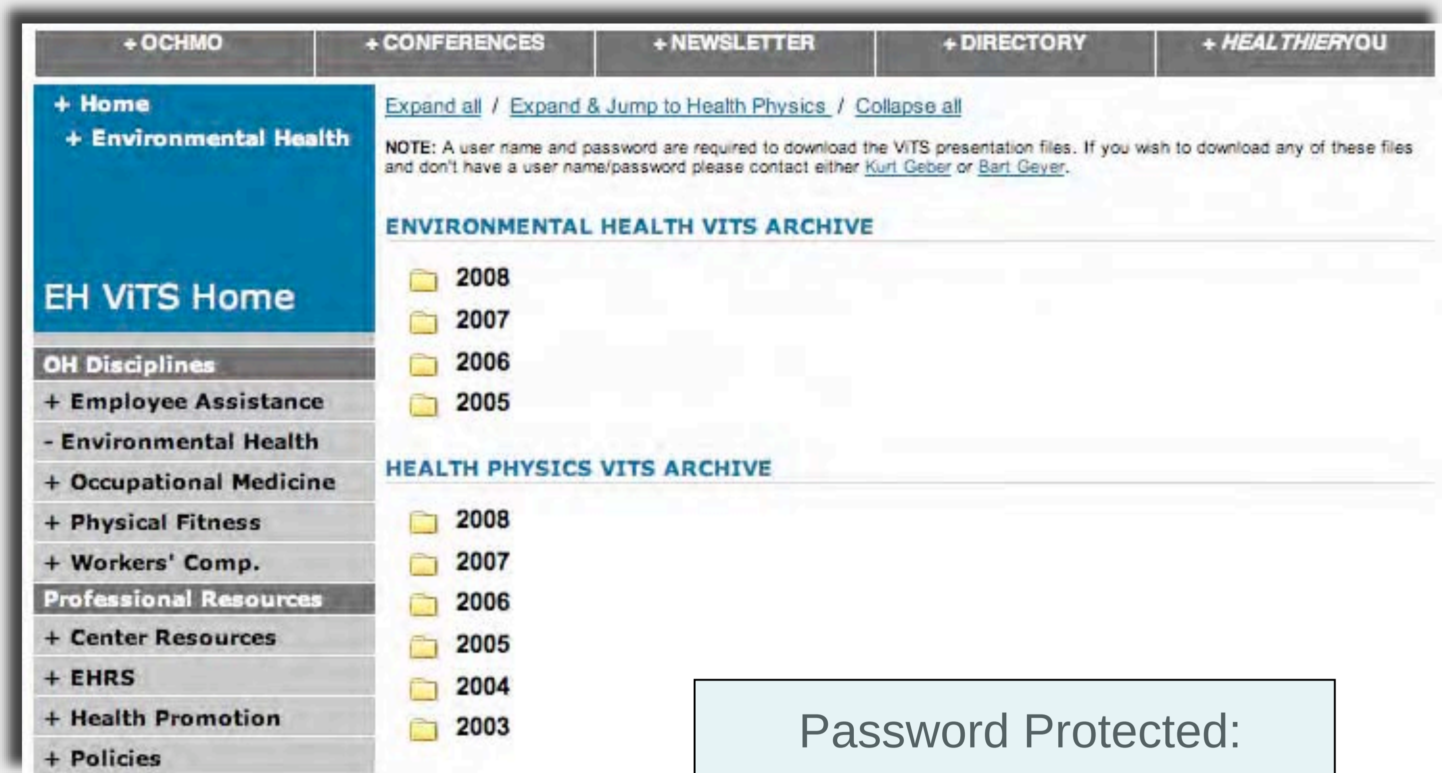
Environmental Health Resources



EH Online Resources

- Federal Register Search
- NRC Reference Library
- NASA Technical Standard
- Health Physics Society
- Laser Institute of America
- Lots more…

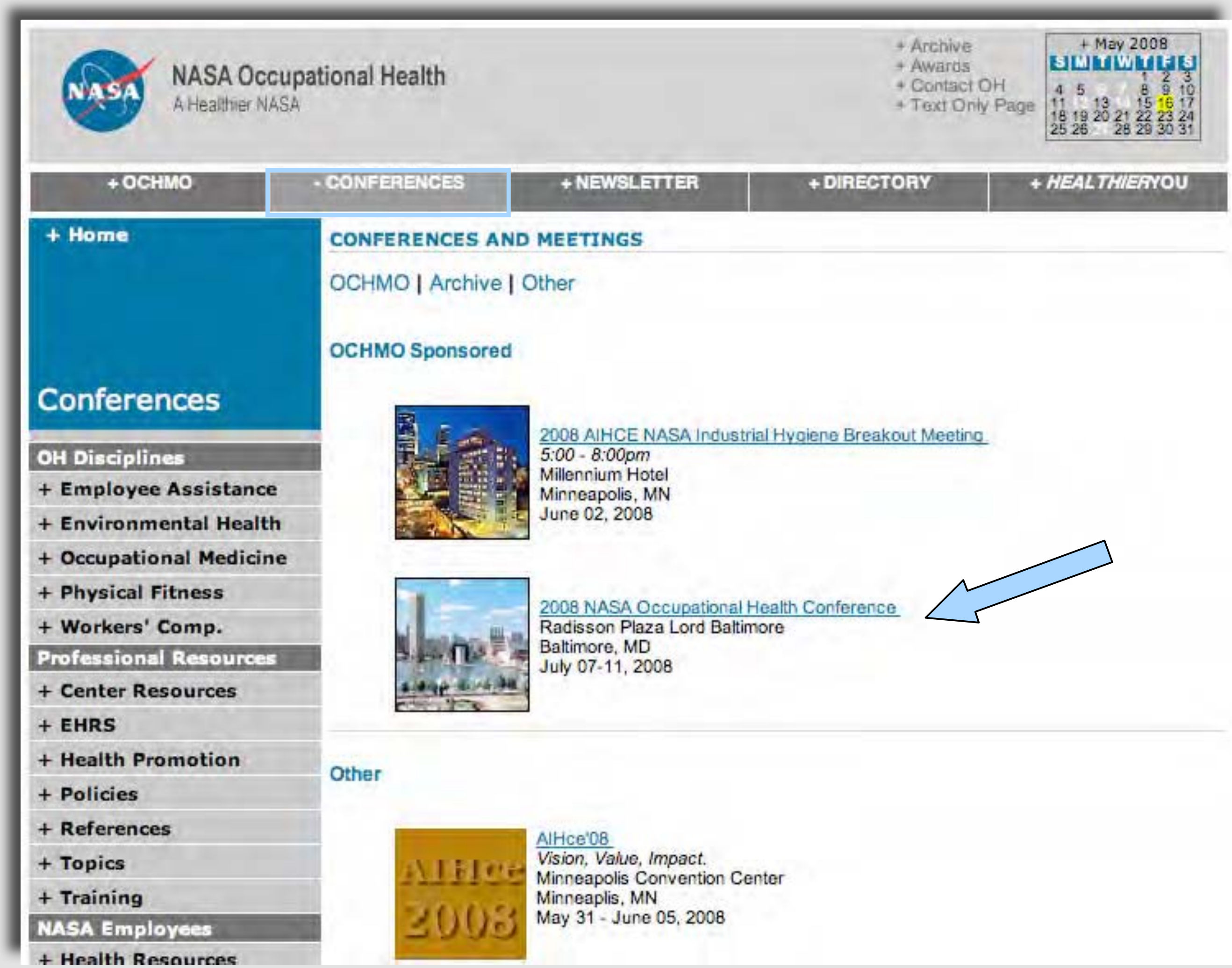
ViTS Archive



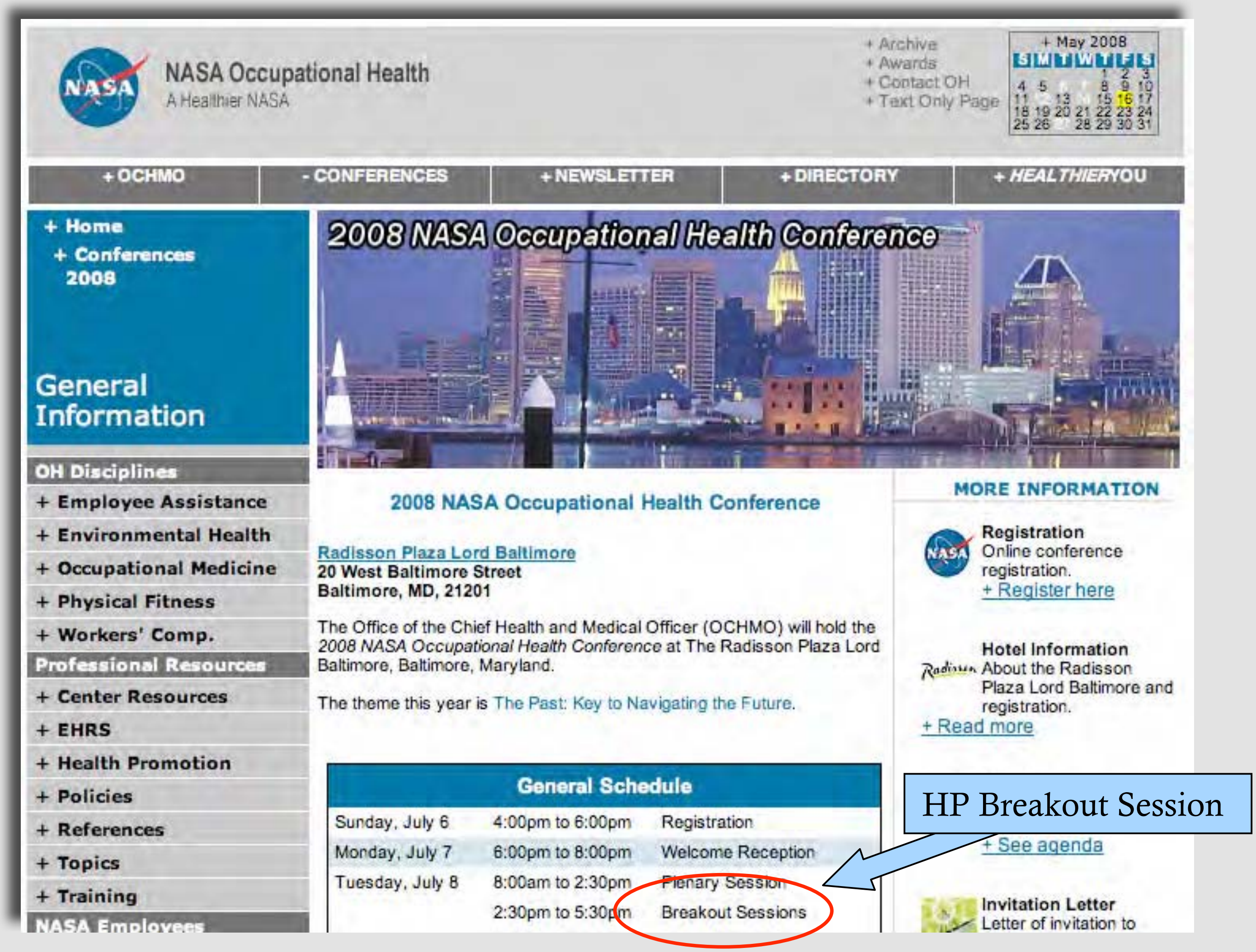
Password Protected:

Contact Kurt Geber or Bart Geyer for assistance

Listing of OH-Related Conferences



2008 OH Conference



Health Physics Breakout Session

"The Most Powerful Tool for Effective Risk Communication - Active Listening"

Ray Johnson, CHP

Health Physics Policy Update

NPR 1800.1, “Occupational Health Program Procedures”

1. General requirement for RPP
2. Radioactive Materials
3. Radiation Generating Devices
4. Radiofrequency and Microwave Emitters
5. Lasers and Non-Laser Optical Sources

General Requirements:

- Ionizing and non-ionizing
- ALARA
- Written Program & Implementing SOPs
- Use Authorizations
- Ann. Review of Content and Implement.
- Comprehensive Inventory
- Surveys & Monitoring

Questions

Kurt Geber
Dynamac Corporation
Occupational Health Support Office
Mail Code: DYN-4
Kennedy Space Center, FL 32899

(321) 867-4795
kurt.r.geber@nasa.gov

Conference Summary and Closing Remarks

G. Camomilli

Office of the Chief Health and Medical Officer

5/16/2008